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Hon. Bette Stephenson, M.D., Minister
Dr. H.K. Fisher, Deputy Minister

Curriculum Ideas for Teachers 1980

This support document to *The Formative Years*, one of a series dealing with the conservation of energy, provides information, student material, and suggestions to teachers for presenting this topic in the Junior Division.

Food and Human Energy

Energy J2

Contents

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Writer:
Laurie Ayres
Baythorn Public School
York County Board of Education

Art work based on original drawings by:
(Mrs.) Jean Duran
Master Teacher (Art)
York County Board of Education

Co-ordinators:
John C. Cornfield
Science Consultant
Ottawa Board of Education

Jack G. Davis
Education Officer
Elementary Education Branch
Ministry of Education

Contributors and Validators:
Michelle Cherutti and
Michelle Keyzer, students
Devins Drive Public School
York County Board of Education

Dave Dacey
E.J. Sand Junior Public School
York County Board of Education

Giles Endicott
Research Associate
Waste Management Advisory Board

Jim Forbes
Devins Drive Public School
York County Board of Education

Moe Jacobs
Baythorn Public School
York County Board of Education

Pat McLeod
Baythorn Public School
York County Board of Education

Donovan Olds
Woodbridge High School
York County Board of Education

Introduction

Studies related to food have traditionally dealt with its nutritional aspects, and with its relative abundance or scarcity in different parts of the world. This resource material does the same and much more. Concepts basic to every aspect of food are discussed, and suggestions regarding activities and support materials for a study of food are provided.

Initially, the document looks at the body as a group of systems. Nutrients fuel the systems (Activity Set 1). The nutrients themselves are part of other systems (Activity Set 3), or food chains, which build the pyramid of life (Activity Set 4). The importance of the maintenance of a balance between food energy taken in and food energy used by the body is explored in terms of growth patterns, diets, and the effect of imbalances (Activity Set 2).

The effect of the interdependence of life systems and of interventions in them is briefly explored, as is the idea of the sun as the originator of life and energy (Activity Set 3). The wise selection of foods is encouraged for nutritional reasons (Activity Set 1) and for ecological reasons (Activity Set 4).

The efficient use of soil (Activity Set 5) and food (Activity Set 6) are discussed, and the conditions required for growing food and the limitations on its production are considered. An example is provided of the efficient use of an animal killed for food, and different ethics of consumption are considered (Activity Set 6). New techniques for producing and processing foods are given, as is instruction in using growing space creatively (Activity Set 7).

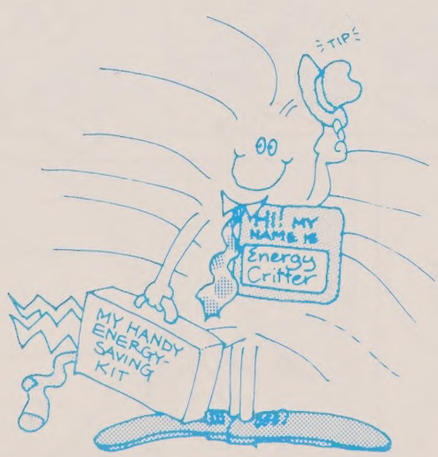
The idea that the food product that is processed, packaged, transported, stored, and commercially promoted is much more energy-intensive than the product that is grown, picked, and prepared at home is presented (Activity Set 8), as are alternatives that afford students real choices about energy consumption with regard to food processing (Activity Set 9). These ideas are considered within the framework of a discussion on the merits of the self-sufficient community as opposed to interdependent communities (Activity Set 12). A variety of possible future community alternatives are also proposed in this unit (Activity Set 13).

The notion of "garbage" as energy is introduced in this document (Activity Set 10); the disposal of wastes and the production of methane gas are aspects of this idea that are touched on.

The significance of food and its presentation in public and in private is explored (Activity Set 11). Because food choices are personal, the significance of foods varies widely. Special foods are a part of many religious rituals; "national" foods have deep roots within ethnicity. In this respect, food contributes to a strong feeling of unity within a group, which may have far-reaching consequences.

The availability of materials for carrying out projects and student interest should determine, to a large extent, the work undertaken. You are urged to select the ideas from this document that you feel best suit your students and community. This may mean that some units are eliminated completely, some followed closely, and others adapted to fit your specific situation. You should also decide the sequence of presentation of the material in this guide, based on the needs and interests of your students.

It is hoped that both you and your students may develop, through your work in this area, wisdom in the management of food, one of our most important energy resources.



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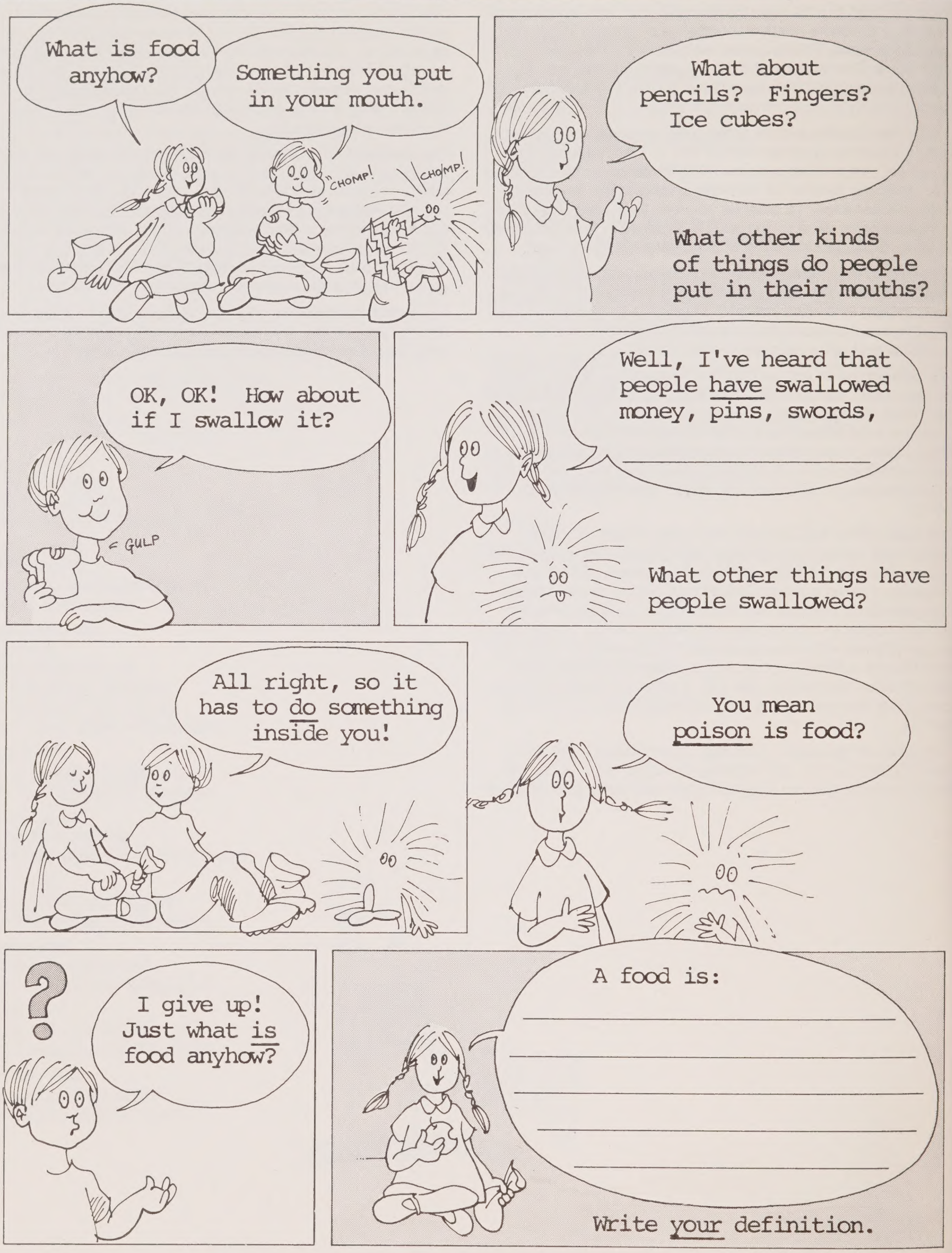


You may want to look at your definition again after you have studied food further. See if your definition changes.

What Is Food?

Notes

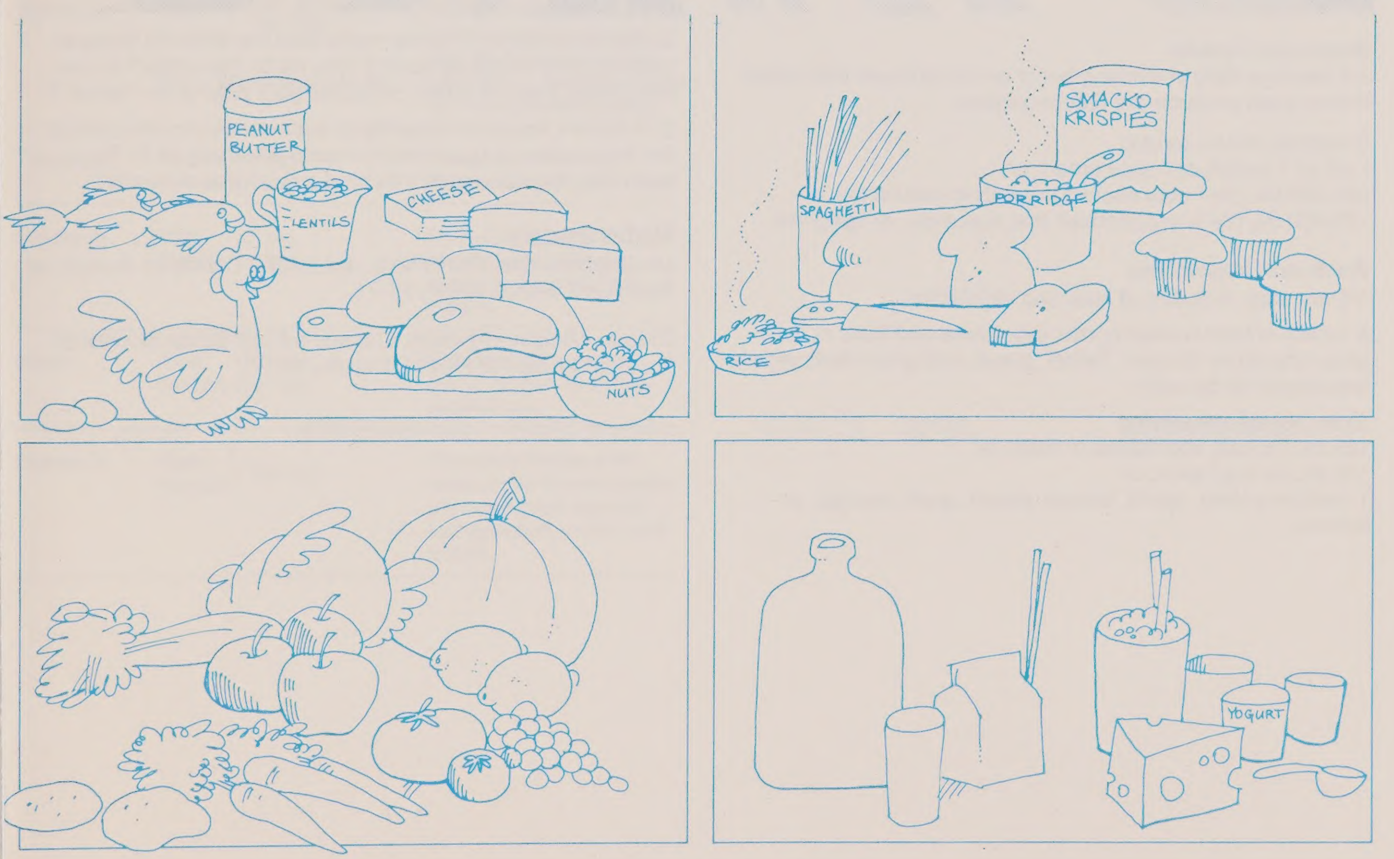
In this activity, students should:

1. define what food is, and
2. examine daily nutritional requirements.

Adequate nutrition, which is essential for energy and efficient body functioning, should be a goal for each of us. Students should be asked to draw up a balanced diet for one day. They should then check their menus against Canada's Food Guide to ensure that they have included all the groups of foods recommended in the guide in the suggested amounts. (See Figure J2.1.) Students should review the food groups and should become aware of the nutrients necessary for body growth and repair. They should develop an understanding of the amount of energy contained in a Calorie (4.2 kJ), and therefore of the amount of energy provided by the food they eat.

Students should complete the student activity sheet at the outset of this unit; they should define food again at the end of the unit. The reasons for any changes in their definitions of food should be discussed.

Figure J2.1: Food Groups



Canada's Food Guide

A variety of foods from each group should be eaten every day.

Energy needs vary with age, sex, and amount of activity. Foods selected according to the guide can supply 4185 to 5859 kJ of nutritional value. For additional energy, the number and size of servings from the various food groups can be increased or other foods can be added.

Milk and Milk Products

Children up to 11 years	2-3 servings daily
Adolescents	3-4 servings daily
Pregnant and nursing women	3-4 servings daily
Adults	2 servings daily

Skim, 2 per cent, whole, reconstituted dry, or evaporated milk or buttermilk may be used as a beverage or as the main ingredient in other foods. Cheese or yogurt may also be chosen.

Examples of one serving
250 mL (1 cup) milk, yogurt, or cottage cheese; or 45 g (1½ ounces) cheddar or process cheese.

A supplement of vitamin D is recommended when milk that does not contain added vitamin D is consumed.

Meat and Alternates

2 servings daily.

Examples of one serving
60-90 g (2-3 ounces) cooked lean meat, poultry, liver, or fish; or
60 mL (4 tablespoons) peanut butter; or
250 mL (1 cup) cooked dried peas, beans, or lentils; or
80-250 mL (⅓-1 cup) nuts or seeds; or
60 g (2 ounces) cheddar, process, or cottage cheese; or
2 eggs

Bread and Cereals

3-5 servings daily of whole-grain or enriched bread and cereal. Whole-grain products are recommended.

Examples of one serving
1 roll or 1 muffin; or 1 slice bread; or
125-250 mL (½-1 cup) cooked or ready-to-eat cereal; or
125-200 mL (½-¾ cup) cooked rice, macaroni, or spaghetti.

Fruits and Vegetables

4-5 servings, including at least two vegetables.

A variety of both cooked or raw vegetables and fruits or their juices should be chosen. Yellow, green, and green leafy vegetables should all be eaten.

Examples of one serving
125 mL (½ cup) vegetables or fruits; or
125 mL (½ cup) juice; or
1 medium potato, carrot, tomato, peach, apple, orange, or banana.

Follow-up Activities

1. The energy package we call the body has many systems within it. Each system requires nutrients, without which the body cannot function efficiently. Have students create a chart, based on the human body. Various aspects of the body (e.g., the skin, skeleton, muscles, brain and nerves, and the sensory, digestive, circulatory, respiratory, excretory, and reproductive systems) should be included. Beside each aspect, the nutrients that are vital to its functioning should be listed. (Information for this activity is to be found in Table J2.1.)

2. As an alternative to the first activity, students could trace the effects that a hamburger or some other favourite food has on the body.

3. Students could find out how many kilojoules they eat at a meal (or in a day) using the charts in the booklet entitled *Nutrient Value of Some Common Foods* (Ottawa: Minister of National Health and Welfare, 1979). This amount could then be related to the quantity of water they could heat with their body's energy input for the allocated time span. Would they heat as much as a bathtub full (160 L)? How many days' kilojoules equal one warmed swimming pool? How many French fries are required to produce the energy necessary to raise 1 L of water to the boiling point (100°C) from room temperature (20°C)? Students can set themselves other, similar problems. They should remember that in energy conversions there is a loss of 10 per cent of the potential energy with which they started.

Related Activities

The following are some additional questions and activities that students can explore:

1. What do additives, colourings, chemicals, or preservatives contribute to your body and/or energy requirements?

2. Are the contents of home-made food the same as those of commercially prepared foods? Why might they differ? Is one kind better than the other? What are your criteria for "better"?

3. Is there a maximum quantity of each nutrient beyond which the body does not use it and/or reacts adversely to it? For example, does too much milk produce calcium deposits?

References

Le Clair, Maurice, and Willard, Joseph W. *Canadian Bulletin on Nutrition* 6 (March 1964), 70-71.

Ontario, Ministry of Health. *Canada's Food Guide Handbook.* Toronto: Ministry of Health, Ontario, 1977.

Table J2.1: Beyond Food Groups

Nutrient	*Daily Recommended Amount for Ages 10-12*	*What It Is Used for by the Body*
Energy	Male 2500 kcal 10.5 MJ Female 2300 kcal 9.6 MJ	Characteristic activity pattern for ages 10-12.
Protein	Male 41 g Female 40 g	Growth; replaces nitrogen that is lost via urine, faeces, and skin; helps the body meet stress, including infections.
Fat	Up to 25 per cent of total energy value (kilojoules).	Vehicle for fat-soluble vitamins; supplies fatty acids; aids in the absorption and utilization of other nutrients; a source of energy.
Carbohydrate		Supplies calories.
Calcium	Male 900 g Female 1000 g	Promotes growth; aids in the development of bones and teeth.
Phosphorus	At least as much as calcium.	Aids in the development of bones and teeth.
Iron	Male Female 11.0 mg	Aids in the production of hemoglobin in the blood.
Vitamin A	Male } 800 RE Female } RE = retinal equivalents	Promotes healthy skin, eyes, bones, and body growth; aids the body in resisting infections; promotes longevity; helps prevent senility.
Thiamine	Male 1.2 mg Female 1.1 mg	Releases the energy from carbohydrates.
Riboflavin	Male 1.5 mg Female 1.4 mg	Involved in growth and metabolism; related to energy production from protein.
Niacin	Male 17.0 mg Female 15.0 mg	Essential to the proper use of oxygen for energy expenditure.
Vitamin B	Male } 3.0 mg Female }	Promotes healthy skin; helps prevent convulsions; promotes good appetite and digestion, growth, and fertility.
Vitamin C (ascorbic acid)	Male } 30.0 mg Female }	Prevents scurvy; helps in the maintenance of good health; aids in tooth and bone formation; helps heal wounds; important to the development of red blood cells; aids the metabolism and glandular activity.
Vitamin D	400 I.U.	Prevents rickets; aids normal growth and bone formation; regulates blood calcium.
Water	1 L/4185 kJ (about 2/3 will be obtained from food)	Essential to the process of Caloric expenditure and the processing of nutrients.

The amounts quoted are the recommended international units per day, which are related in some instances to the total weight of the individual and in other cases to the total Caloric intake. The Calories referred to are "kilocalories" or "large" calories. A Calorie is the energy required to raise the temperature of 1 L of pure water by 1°C. In metric terms, a Calorie equals 4.2 kJ (kilojoules), the unit we will use for calculations in these activities.

Source: Adapted from *The Revised Dietary Standard for Canada,* no. 39, Cat. No. H58-26/1975 (revised winter 1977)

Activity Set 2: Balance Sheet

Name:

Balance Sheet

In		Out	
Food Eaten	Kilojoules	Activity	Kilojoules Used
1 large milkshake (about 500 mL at 1526 kJ/ 250 mL)	3052 kJ	8 h sleep at 280 kJ/h	2240 kJ
Total	**3052 kJ**	Total	**2240 kJ**

Instructions

1. Keep track of all the foods you eat in a day, as indicated above. (Yes, that includes a stick of gum and a soft drink, as well as meals and other snacks.)
2. Change the food eaten into kilojoules.
3. Record the number of kilojoules you consumed during the day.
4. Keep track of all activities in a day (even such activities as sleeping).
5. Record the number of kilojoules you used up in your activities.
6. How did you balance out?
7. Do you need to make any adjustments?

Balance Sheet

Notes

This activity directs attention to the need to balance the food energy units taken in by the body with the energy units expended in activity. Students should be able to recognize the causes and effects of different proportions of energy input to energy output.

This activity set could be introduced through a discussion of the size and growth differences among individuals within the class. Following this, students could be asked to complete a "Balance Sheet" based on the sample provided.

Students who are too thin or too fat may wish to speak privately with the teacher to avoid embarrassment, if they discover a serious imbalance between what they eat and their amount of activity. Obese and/or malnourished students may be referred to the school health nurse, a family doctor, or to other health service people in the community. Remember that you are not in the medical profession, but you may make referrals to it.

The activity chart (Table J2.2), which gives the kilojoules used per hour for specific activities, may be duplicated for students or posted on the bulletin board. The kilojoules found in specific foods are to be found in the booklet entitled *Nutrient Value of Some Common Foods.*

The physical appearance and available energy of each person is directly affected by the balance between energy input (in the form of kilojoules) and energy expended (in the form of exercise). There may be some variations caused by individual growth patterns and glandular differences, but generally there is a direct relationship between food eaten, activity, and the general appearance of each individual.

Table J2.2: Activity Chart

Activity	Kilojoules Per Hour
Sleeping	280
Mental work	335
Sitting	352
Standing relaxed	389
Writing	414
Dishwashing	552
Playing cards	615
Dusting	720
Sweeping the floor	720
Power boating	766
Washing the car	766
Walking (3.2 km/h)	791
Bowling	929
Fishing	929
Horseshoes	929
Canoeing (1.5 km/h)	963
Horseback riding	1076
Ice boating	1076
Archery	1076
Sailing	1076
Bicycling (3.0 km/h)	1105
Walking (4.8 km/h)	1105
Table tennis	1230
Golf (no cart)	1230
Laundry, by hand	1268
Walking (6.4 km/h)	1406
Volleyball	1465
Roller skating	1465
Badminton	1465
Gardening	1536
Dancing, slow	1536
Bicycling (15.3 km/h)	1758
Hiking (or hunting)	1846
Dancing, fast	1846
Water skiing	1846
Shoveling	1846
Climbing (10% grade, 4.8 km/h)	2109
Basketball (no game)	2461
Tennis	2461
Downhill skiing	2461
Climbing stairs	2549
Running (8.8 km/h)	2549
Swimming (breast stroke, 36.6 m/min)	2549
Bicycling (20.9 km/h)	2758
Rowing	2900
Tobogganing	3076
Ice skating (vigorous)	3235
Swimming (crawl, 45.7 m/min)	3340
Handball	3691
Running (12.9 km/h)	4218
Cross-country skiing	5009
Competitive skiing, running, rowing, and swimming	6018

(Figures given were computed for a 68 kg person. Lighter persons use up fewer kilojoules; heavier persons, more.)

Source: Adapted from Kenneth D. Rose and Jack Dies Martin, *The Lazy Man's Guide to Physical Fitness* (Rexdale, Ont.: Coles Publishing Co., 1974), pp. 103-7.

Follow-up Activities

1. Have students develop a diet to enable them to lose 5 kg of weight, keeping in mind that 1 kg of fat to be lost is equal to 32 225 kJ not to be eaten. They should decide how long they will take to lose this weight if their activity level remains constant. They should consider the following factors in developing their diets:

a) Are daily food requirements being met?

b) If weight is lost rapidly, will there be side effects such as irritability, headaches, or weakness?

c) Under what conditions should medical advice be sought? (Such conditions might include cases of extended dieting, health problems such as diabetes, or deficiency-related ailments.)

d) Where or how would they insure getting the food energy they need from the right foods? For example, does the cafeteria offer appropriate foods? Does the student pack a "balanced" lunch?

2. Have students set up a program to lose 5 kg of weight through exercise and activity, while maintaining their daily food intake at its present level. What activities will they make part of their daily routines? What factors must be considered before starting such a program? For example, is there a heart problem that might be aggravated? How much time can be given to the activities?

3. Have students develop a program for losing 5 kg of weight in which both the number of kilojoules of food eaten is reduced and the activity level is increased. They should consider the following questions: What factors would have to be considered? Should the time needed for weight reduction increase or decrease? By how much?

4. Have students reverse the goal of the preceding activities, so that they plan to *gain* 5 kg of weight.

Related Ideas

1. Students may wish to examine several "fad" diets for their nutritional soundness (e.g., the "protein" diet, the "banana" diet, etc.).

2. Eating patterns in other cultures may be researched and compared with the students' eating habits. For example, students might consider the eating habits of the aborigines of Australia, the Inuit, or vegetarians of any specific country. They should consider why the eating habits have developed in the way they have and how they have affected the people.

3. Warm-blooded creatures follow a pattern of fast growth in the years of early childhood. In cold-blooded creatures these patterns are quite different. A snake may eat once in every three to six weeks (a good feature of adaptation when regularity of food supply may be in question). Snakes and fish may reach a certain size and continue to maintain that size even when the food supply is restricted. When an increased supply of food becomes available, growth may again be resumed and continue until maximum size for the species is reached.

Observations may be made over a period of time using "mature" goldfish. In this experiment a number of fish are placed in a tank so that there is one fish per 4.5 L of water. One fish is left alone in a 22.5 L tank. All fish should be of approximately the same age and size to start with. Extra food should be given to the single fish each day. The size of the single fish can be compared with that of the others (a) at the end of a three-month period; and (b) at the end of the school year.

4. Warm-blooded creatures, including humans, need a regular input of energy. (In humans, the frequency of eating is culturally determined.) It is this frequency of energy input that makes warm-blooded creatures feel warmth, since heat is associated with energy activity. Students may wish to discuss the foods that they eat (a) to "warm up" on a cold day; or (b) to "keep cool" in summer. Is there a basis for their eating habits? Why do these habits differ from culture to culture?

References

Health and Welfare Canada. *Nutrient Value of Some Common Foods.* Rev. ed. Ottawa: Health and Welfare Canada, 1979.

Rose, Kenneth D., and Martin, Jack Dies. *The Lazy Man's Guide to Physical Fitness.* Rexdale, Ont.: Coles Publishing Co., 1974.

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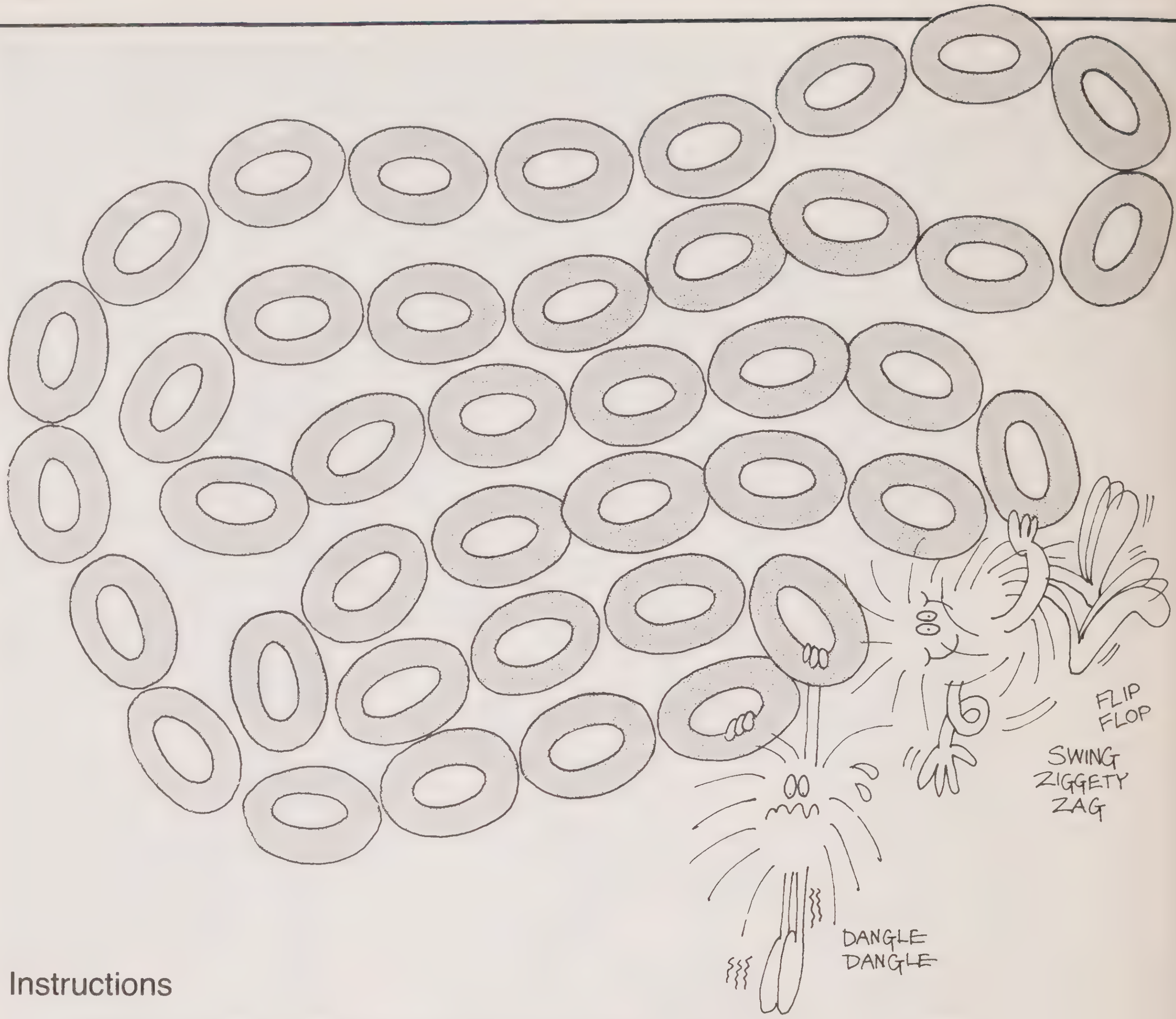


Instructions

1. Add the names printed below to the blank links above.

2. Cut out the links.

3. Make as many food chains as possible to demonstrate how life forms are related in nature's food patterns (e.g., sun-corn-human). Try to use all the pieces.

4. What may cause "breaks" in the chains in nature?

sun				
plankton	seaweed	corn	robins	turtles
worms	melons	wheat	owls	June bugs
ants	squash	sharks	mice	cows
beetles	potatoes	codfish	dogs	chickens
mosquitoes	carrots	bass	cats	rice
bacteria	rhubarb	crows	humans	barley
grass	potato bugs	lobsters	frogs	strawberries
dandelions	butterflies	crayfish	snakes	humus

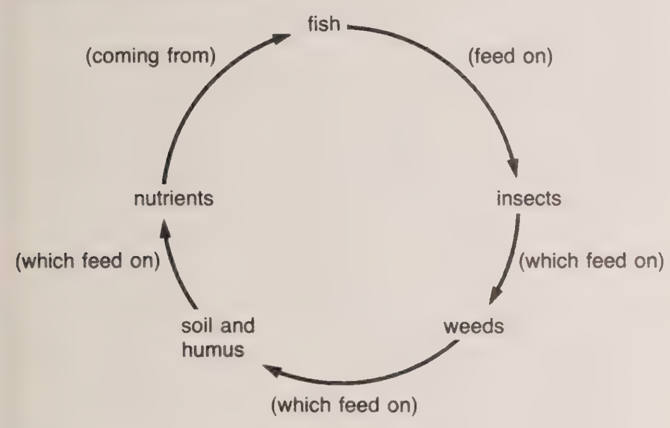
Notes

The focus of this activity set is on the interdependence of systems, the effects of intervening in them, and the sun as the originator of energy on earth.

Students should be encouraged to discuss life cycles and prey-predator relationships before attempting the suggested student activity. At that point they should see: (a) how many variations of the chain they can devise; and (b) what happens when any "link" in their chain is removed. What would be the effects of, for instance, the killing of all insects? Of the sun burning out?

Food input into human systems depends upon the completion of the life chains that support humans. Students should understand: (a) the impact of humans on food chains; (b) the delicacy of the balance between chains and their interdependence (for example, if water-dependent life (fish) were to diminish because of pollution or a scarcity of food, the birds who depend on these fish for their food would also be affected); and (c) that the sun is the originator of life (and energy).

Figure J2.2: Food Cycle



Follow-up Activities

1. Students should be invited to predict and research the effects of weather changes upon food chains. Here are some questions to get them started: What if we had less sun? More sun? How would water systems be affected in each case? How would food chains be affected? What other life-support systems would be affected and how? What differences would there be between the effects of a relatively permanent weather change (e.g., an ice age or a desert formation) and a single "act of God" (e.g., a flood or tidal wave)?

2. Students might examine the effects of human actions within the food supply system. They could do research to uncover the effects of such pesticides as DDT, fertilizers (chemical build-up), land clearing (erosion), the building of cities (increasing temperatures), and overconsumption of a single species (species extinction and changed patterns associated with it). One of the best examples of the last-named intervention is the killing of the buffalo in the West. The resulting changes in the food chain led ultimately to cultural changes.

Similar results are experienced in the North, where life chains have few links and there are few alternatives if a link is removed. Students may wish to find out more about the considerations involved in the James Bay study and/or the Northern Gas Pipeline study.

3. Students with little knowledge of food chains and of what happens when they are changed should experiment with growing seeds under different conditions of sunlight, water, and nutrients. For example, two containers of soil may be planted with equal numbers of radish seeds. (Radish or bean seeds mature relatively quickly.) Both containers should receive the same amount of daily watering, but one container should be placed in the sunlight, the other in the dark. A diary of daily observations may then be made.

Related Ideas

1. The effects of introducing a predator into an environment may be determined by placing grasshoppers or hermit crabs in a closed water cycle which is producing plant life (a sealed terrarium in which some plants are growing). Students will observe that these predators soon destroy the plants by either eating them, digging them up, or tramping them down. The parallel with human activity may be drawn.

2. Students might play a modified version of "Fox and Geese", in which there is initially one predator and many prey within given boundaries. The "predator" catches as many "prey" as possible within a set time by tagging them. How many "prey" are left to produce their species? The game is then played again with an increased number of predators. How many prey are now left? There are no winners or losers in this game, only conclusions to be drawn at the end. Students might consider the following questions: What would happen to the predator if it caught all of the prey? None of the prey? Some of the prey? What would happen if the number of predators was increased by one? By five? By twenty-five? What if the prey became diseased or could not replenish their numbers?

3. Some students may wish to do individual research and make presentations on the specific effects of humans upon nature. Rachel Carson's *Silent Spring* is recommended reading for the advanced student who wishes to delve more deeply into this topic. Other advanced students might wish to develop playlets or skits presenting "life within the food chain". They might take one of the following as their theme: "life as the conversion of energy", "the nature of energy", "the prey-predator relationship"; or they might select a theme of their own choosing. Students should consider whether their presentations will be in print form, audio form, visual form, or some combination of all three. One day or a series of days could be set aside for presentations.

4. Students might wish to look into the topic of plant and animal adaptation. The following are some sample questions: How do plants and animals survive temperature changes? How long does it take them to adapt? What kinds of changes can take place and to what extent? What factors help change? Hinder it? How do humans change? Make changes? Control changes? You and your students may think of other directions to explore.

Reference

Carson, Rachel. *Silent Spring*. Boston: Houghton Mifflin, 1962.

Name:

ME 'N' U for Ecology

Instructions

1. Select a number of interesting foods to serve as a menu for a party.

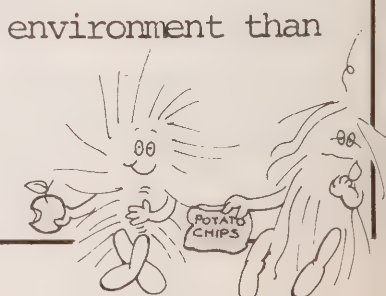
2. Beside each item, note from which level in the food chain it comes.

3. Can you substitute food items from a lower level in the food chain for your first choices? Substitute as many as you can, but keep the menu interesting in its variety.

4. Is your final menu different from your original one?

5. Is it taking less potential energy out of our environment than the first one?

6. Would you enjoy your final menu as much as your first one?



Notes

The foods we eat are usually selected because of cultural, social, and individual habits. Rarely is a decision made on the basis of how the selection will affect the total environment.

The "Me 'N' U for Ecology" activity is directed towards:

1. student recapitulation of data from the "pyramid of life food chains"; and

2. a practical application of those data within their own life experiences.

The food we eat comes from food chains found at different levels of the pyramid of life. Students should examine the levels and develop an appreciation of the fact that each level develops one unit of energy from ten units at the next lower level. Thus, the energy production sources at each level must be greater in quantity than those at the next higher level. Within the terrestrial food chain, then, the number of herbivores must be greater than the number of carnivores, and the number of producers must be greater than the number of herbivores.

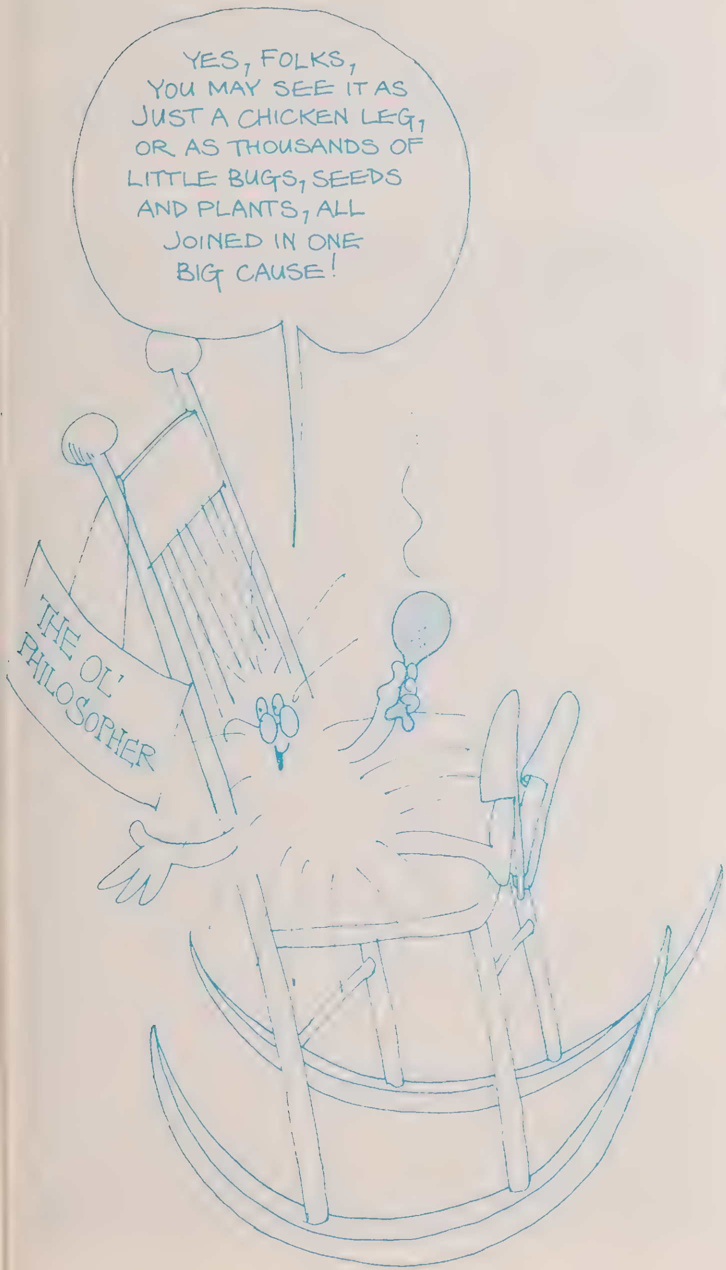
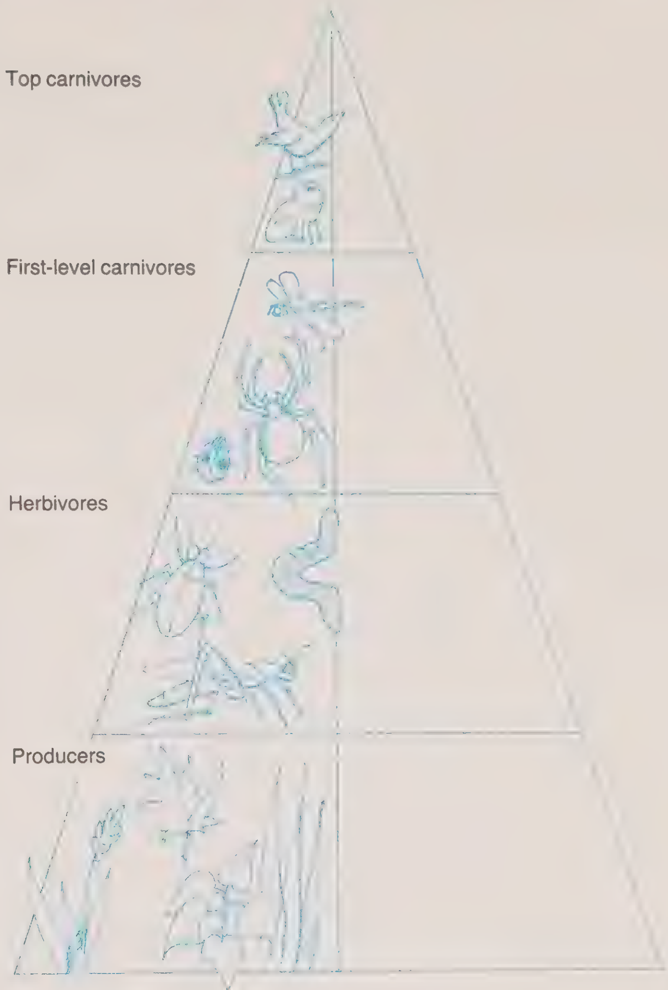
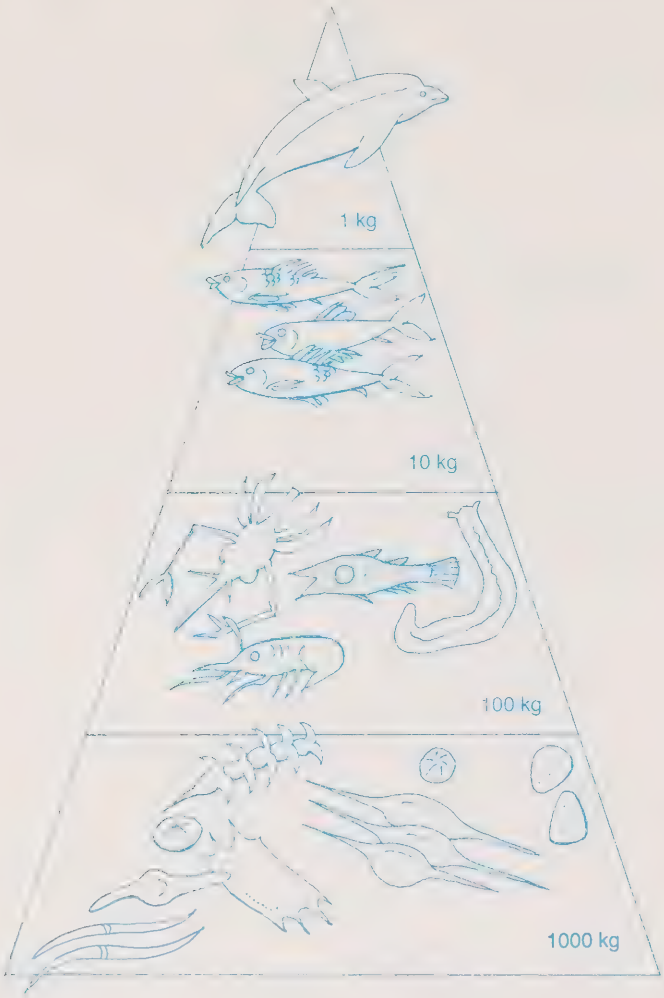


Figure J2.3: Terrestrial Food Chain



Have students add more examples to each level of the chain.

Figure J2.4: Marine Food Chain



It takes 1000 kg of living matter from the sea for a mammal to gain 1 kg. Larger fish eat smaller fish, which eat lower-level animals and plants. The plant plankton, which are the producers here, capture the sun's energy through photosynthesis.

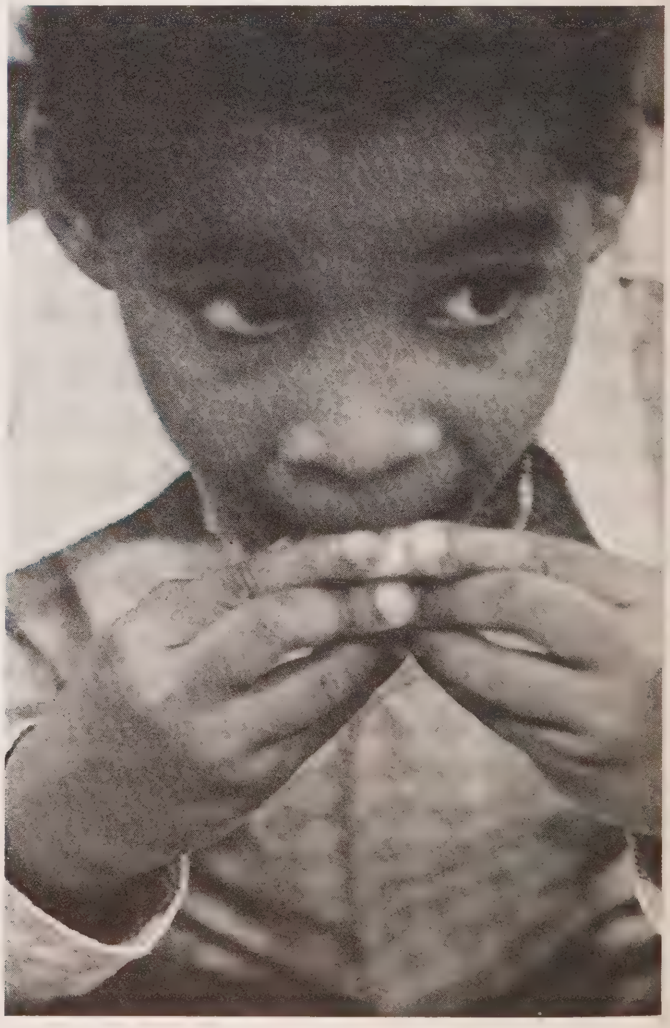
Similarly, the producers in the marine food chain must greatly exceed the numbers of the final consumers.

These are the food chains that form the pyramid of life. Students may wish to extend these pyramids by adding more examples of each level of life from their own knowledge.

The main concept to be gained is that the higher the level from which a food is selected, the more that selection removes from the total environment. Conversely, the more foods that are selected from close to the base of the pyramid, the less is removed from the earth's storehouse. Students should begin to make their food selections not only on the basis of their needs and the availability of choices, but also on the basis of the amount of energy they remove from the total environment. In this way, energy cost to the environment can be reduced.

At the outset of this activity, students should be asked to make up a menu that would be appropriate for a party. A discussion of the pyramid of life should follow, with the students identifying the levels from which they have selected foods.

Substitutions of various items should be discussed. Which alternatives are considered "acceptable"? What is the basis for accepting or rejecting alternatives? Final menus that incorporate the substitutions should then be made up and compared with the original menus. Comparisons should be based on ecological concern and potential enjoyment.



Follow-up Activities

1. Consideration could be given to the effects of location on food consumption. Would the menus differ if eating locations were different (e.g., if the food were eaten in a restaurant rather than at home)? Menus from local restaurants could be used for purposes of comparison. Additional comparisons between restaurants could be made if there are alternatives available within the community.

2. Research could relate geographic and climatic conditions to food-consumption patterns (e.g., the eating of insects and lizards by Australian desert-dwellers; the eating of fish in many island or coastal areas of the world; the eating of buffalo on the Prairies by people living there in the early 1800s). Students could consider why people adopt the eating patterns they do.

3. Specific menus could be evaluated in terms of their dollar costs, or in terms of their nutritional value. These evaluations could take the form of consumer reports.

Related Ideas

The students might explore the following questions and ideas:

1. What reasons may a person have to become a vegetarian?

2. How would you persuade other people to try new food experiences? To adopt new eating patterns?

3. How do chemicals build up in a food chain?

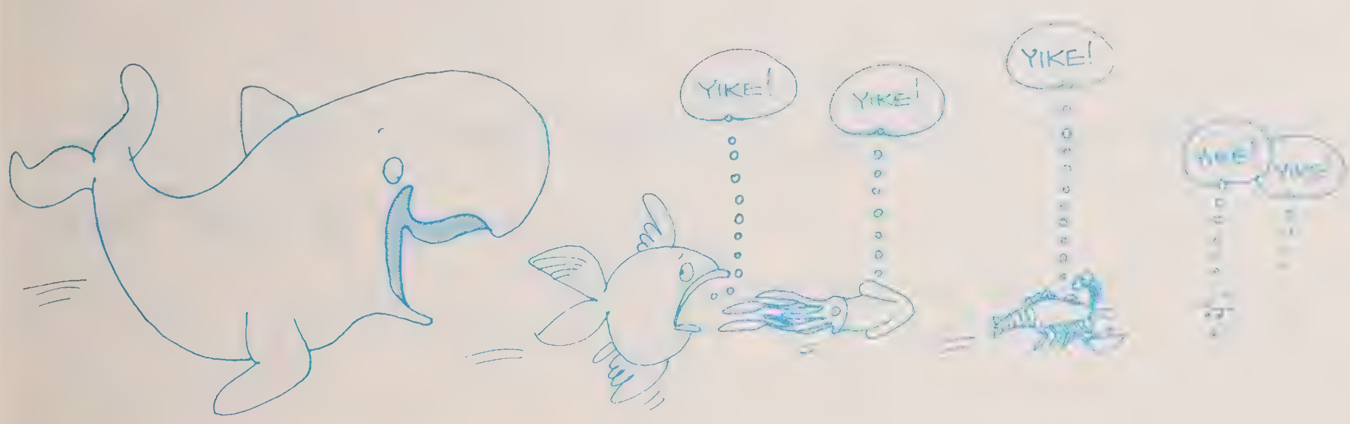
4. How does the pyramid of life relate to the nature of energy? (Energy forms can be changed, but there is a loss with each conversion.)

5. What is the original source of food energy and what is the method of conversion of energy? (The sun is the source, and energy is first converted through photosynthesis.)

6. How do we determine what is renewable energy and how do we distinguish it from non-renewable energy? (The time needed to change plant and animal energy into fossil fuels should be considered.)

Reference

Adapted from *Pyramid of Life Food Chains* (chart). Skokie, Ill.: Sargent-Welch Scientific Company, 1972.



Name:

Let's Find Out About Growing Things

The purpose of this activity is to determine how we can get the most nutrient energy out of the soil.

Instructions

1. Arrange 1 L of soil in a container (or containers).

2. Plant the number of seeds that you feel will grow best in the soil.

3. Keep a daily diary of plant care and progress. In it, record answers to the following questions:

a) How long did it take the seeds to germinate?

b) Did temperature affect the growth rate?

c) How often did you water the plants? With how much water?

d) Was there a growing spot that offered just the right amount of sunlight?

e) How long did it take to produce food from the planting to the eating stage?

f) How many kilojoules were produced?

g) How many kilojoules could you produce in a year, using the same amount of soil?

h) Would this amount be the same if you used a different type of seed?

i) Are there any arrangements of soil, sun, seeds, or water that would produce more food?

j) What would happen if you used the same soil over and over?

k) What is the best set of conditions to produce the greatest amount of food (nutrient energy) from the soil?

Notes

In our world limitations to crop growth are imposed by soil and climatic conditions. Through the activities in this unit, students begin to appreciate what limitations there are to food (energy) production and to draw conclusions regarding wise land usage.

The activities on the student sheet will likely require one class period in which to arrange soil, sun, temperature, and/or water variables, set up the diaries, and plant the seeds. A few minutes at agreed-upon regular intervals for recording will be necessary for the completion of the diaries. (The questions to be answered may be reproduced and placed in the front of each diary, or posted where students may easily refer to them.)

The total experimental time will depend on the length of time required for the seeds with the longest growing period to reach maturity. This information is usually indicated on the back of the seed packages. Ideally, a time span should be provided that allows for more than one planting. Different arrangements and quantities of seed can then be observed, and earlier results can be verified.

Students should be encouraged to predict the results of their experiments, to compare their findings, and to seek out local experts who can give them additional insights.

Depending on student interest and local conditions, this activity may be expanded by using a variety of soils (e.g., sand, clay, or loam) from different local areas. Urban students may use commercially prepared potting soil and soil from the schoolyard.

In some instances, this activity may continue over an entire school year or longer. In others, it may be completed within a single term. Community residents who are knowledgeable about local conditions should be encouraged to become class resource persons, and, where practicable, students should have the opportunity to use the local community as a classroom in which to carry out activities and to make observations. Students might get involved, for example, in the controlled planting and caring for of crops outside of the school. Modifications of this activity may be necessary to make it challenging at different grade levels.

The activities suggested below may be used for enrichment or for work with older Junior-level students. Younger or inexperienced students may require more structured activities. In any case, students should benefit from this unit by learning to respect and care for the land that nourishes them.

Follow-up Activities

1. Students may wish to follow up the work they have done with a study of food production on a larger area of land, either locally or in some other geographic location. Food production may be estimated (or determined from statistics) for a growing season. Students should consider questions such as the following: How many people would the crop feed? What happens if too much (or too little) rain falls at the start of the growing season? At other, specified times up to and including harvest time? How do people find alternative sources of food under these conditions? (They might plant a second crop, or a different crop, or import food.) How do they get all necessary nutrients in a one-crop situation?

2. Have students write an account of the changed production pattern that would result if the shores of Hudson's Bay and James Bay receded by at least 200 km as average temperatures rose by 10°C. They should use an atlas to determine the new water boundaries, tree line, etc. How do they think their present or future life might be changed by this? Who else might be affected?

3. Have students use the opposite scenario from the last activity and show (in written, art, or dramatic form) what would happen if the temperature average dropped by 10°C.

Related Ideas

Students could explore the following questions and ideas:

1. What would be the best crop (or crops) to raise to provide the most energy for humans (or cows, or chickens) from a given amount of land?

2. What limitations does climate impose upon food production in your county or district? In Ontario? In Canada? In some other part of the world?

3. What have humans done to alleviate limitations to plant growth? (Answers might include the development of new fertilizers, planting techniques, and machinery.)

4. Advanced students might debate the positions found in *Limits to Growth*, which relates food production to population. What would determine "food for all" or "more for a few"?

Reference

Meadows, D., et al. *Limits to Growth*. New York: The New American Library, 1972.

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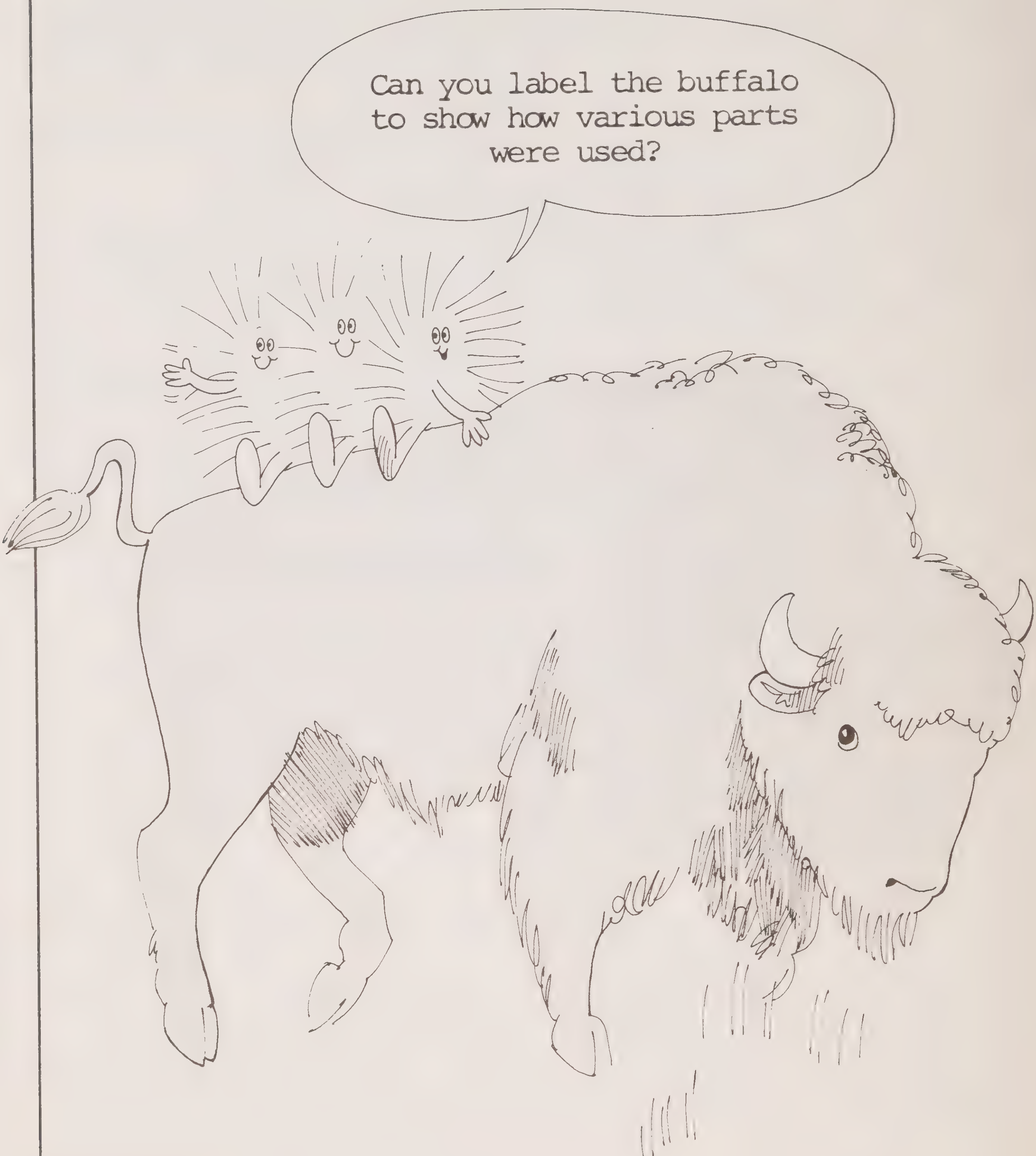


Instructions

1. Label each part of the buffalo according to how it was used by Plains Indians long ago.

2. Can you determine a use for all parts, including the "chips"?

3. Try the same exercise using parts of another animal.

Using All Parts of the Buffalo But the Bellow

Notes

This activity is directed towards the full use of food resources and the elimination of waste. It could fit into a unit on Native studies or be used with the following brief introduction.

The Native people of the West used to regard the buffalo as their main source of food, clothing, heat, and protection. Their ideals were those of the conserver society: "Take only what you need. Use what you take." From the buffalo came hides for tent coverings, clothes, and blankets; food; bones and sinew for weapons and tools; and buffalo "chips" to be burned when wood was scarce on the plains. Even the stomach was used as a container, and certain organs were used as special foods at celebrations.

The Native people had deep respect for the way in which nature provided for human beings, and the buffalo's spirit was honoured by prayers thanking it for its sacrifice.

If this activity is used as a part of a unit on Native studies, the resources listed in the *People of Native Ancestry Resource List*, available from the Ministry of Education, Ontario, will be useful. Additional ideas are to be found in the *Tawow* and *My People* kits.

If deemed desirable, some comparisons may be made with the "code" followed by white hunters.

Follow-up Activities

1. Students could be asked to make a chart of another animal. A great deal of space will have to be allowed for labelling the by-products of all its parts.(Charts may be made by individuals, groups, or by the class as a whole.) From the information found in Figure J2.5, it can readily be seen that commercial food processors (in this instance, meat packers) make full use of the materials that they buy, in order to make the best economic return possible to the business, as well as to minimize waste and to keep prices to a minimum.

2. Students should discuss how good individuals are at saving energy in their own homes. It has been said that "The best-fed member of the family is the kitchen sink." Students may suggest uses for:

a) "leftover" foods;

b) juices left after cooking vegetables, fruits, or meats;

c) milk that has soured;

d) overripe fruits, such as bananas;

e) stale bread;

f) broken cookies and cake;

g) vegetables in insufficient portions for a "family" serving;

h) cracked eggs;

i) cheese that has hardened or gone mouldy.

Students should be encouraged to find other food energy savers. Even using the butter or margarine wrapper to grease a casserole dish counts.

3. Students could be asked to keep a list of leftovers that they have had in their own home over a period of a week. What happened to them? How else could they have been used? Why were there leftovers in the first place?

Related Ideas

1. Students could be asked to calculate the "waste" of leftovers in dollars and/or in kilojoules for a specified length of time.

2. Graphs could be developed to illustrate the frequency of leftovers not being used because of:

a) lack of adequate storage facilities;

b) members of the family getting tired of the same food's being served more than once;

c) fewer people being present at meals than had been planned for;

d) the habit of throwing unused food out;

e) other reasons specified by the students.

3. Students could list items in the home (e.g., leather shoes, soap, meat, medicines, specific pharmaceutical products) that would normally be discarded, and suggest some ways of using them. This could be based on individual observation and recording of by-product usage for a day. Since conservation is a personal decision initially, tasks should be oriented towards the possibility of individual savings, unless there is an indication of family support of the student's undertaking. It should be emphasized that we wish to develop student awareness of food-saving facts, rather than changing family-living patterns.

References

Mann, I. *Processing and Utilization of Animal By-Products.* New York: Food and Agriculture Organization, 1962.

My People. Stratford, Ont.: Scholars' Choice, 1975. $29.95. This kit is suitable for use with students in Grades 5 to 10.

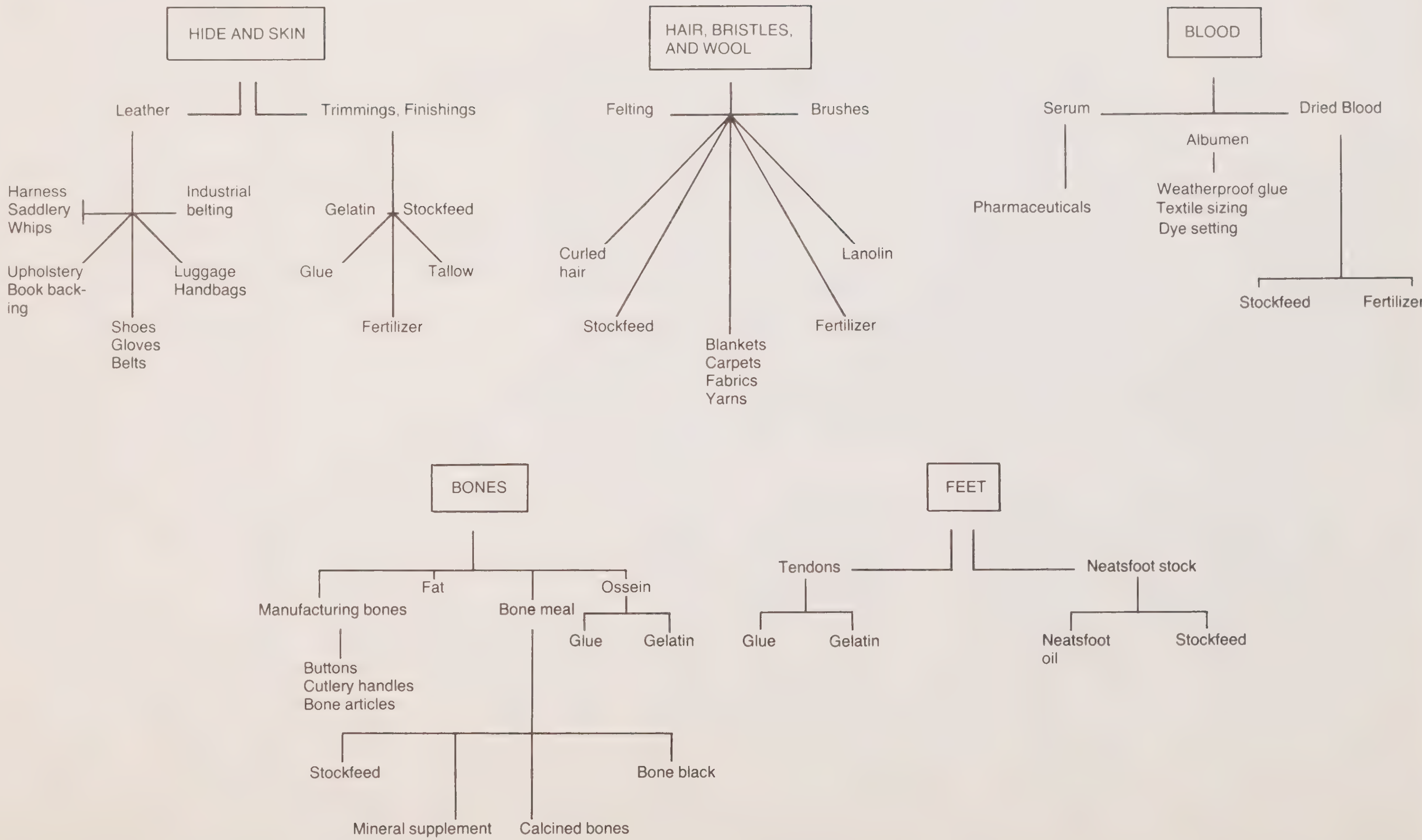
Ontario, Ministry of Education. *People of Native Ancestry: A Resource Guide for the Intermediate Division.* Toronto: Ministry of Education, Ontario, 1977.

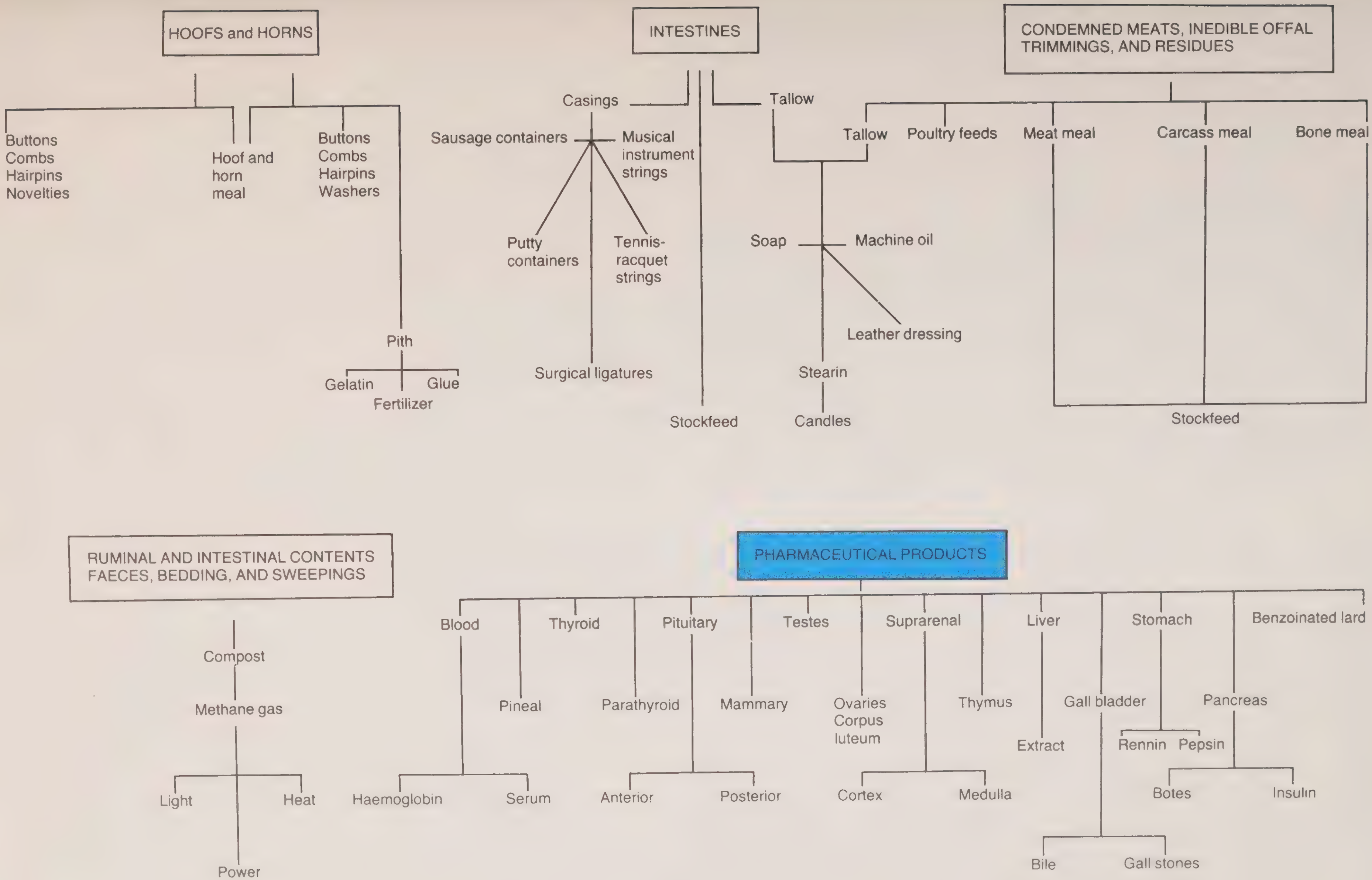
______. *People of Native Ancestry: A Resource Guide for the Primary and Junior Divisions.* Toronto: Ministry of Education, Ontario, 1975.

______. *People of Native Ancestry Resource List for the Primary and Junior Divisions.* Toronto: Ministry of Education, Ontario, 1975.

Tawow. Toronto: Book Society of Canada, 1977. $1.15. This kit is suitable for use with students in Grades 6 to 10.

Figure J2.5: Main By-Products of Animal Origin





Source: I. Mann, *Processing and Utilization of Animal By-Products* (New York: Food and Agriculture Organization, United Nations, 1962), p. 241.

Name:

What's New in Growing Plants?

Stones
+
Chemicals
+
Water
+
Seed
+
Light
+
Time

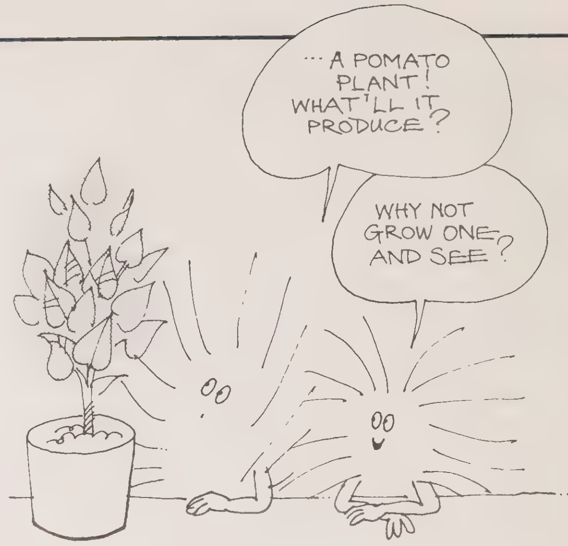
Hydroponics

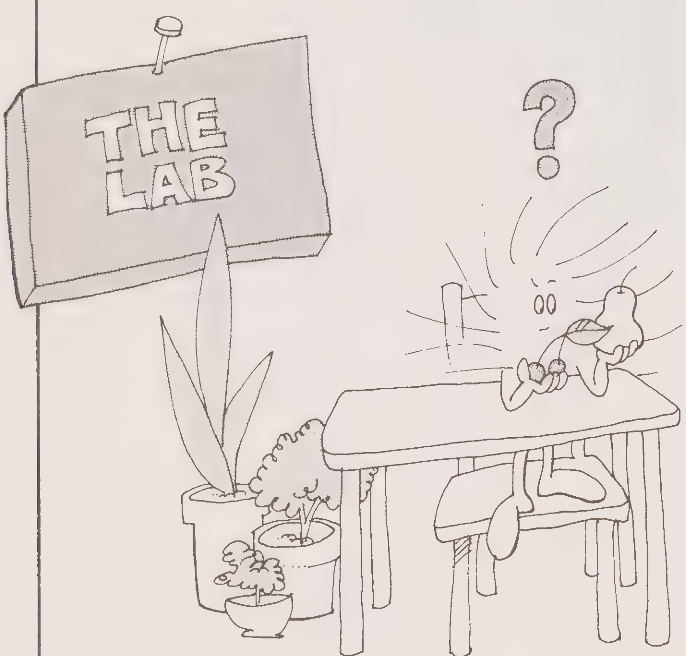
(a new way of growing foods)

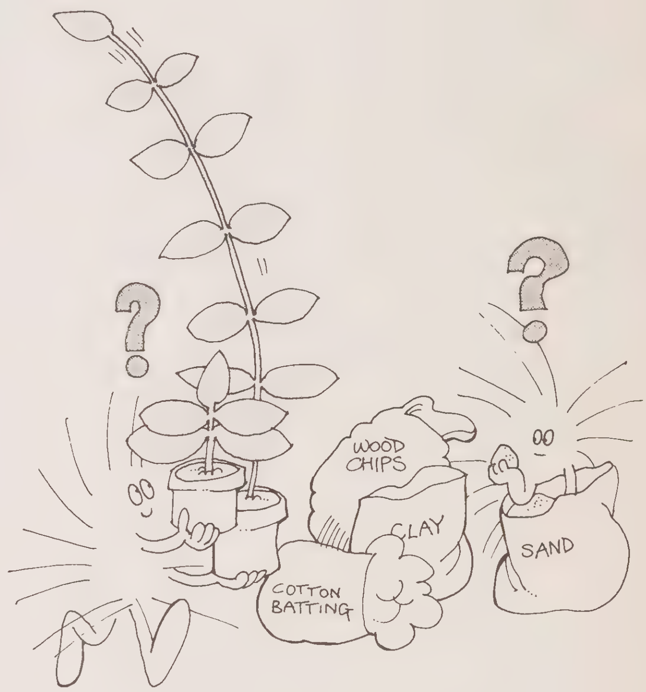
Potato Plant
+
Tomato Plant
+
Soil
+
Light
+
Time

Pomato

(a new plant)







Instructions

Try growing plants using:

1. a new way of growing;
2. crossbreeding (to produce a new plant);
3. selective breeding (to produce an improved plant);
4. your choice of factors.

Notes

People have always experimented with foods and their production. The first people had to find out what was edible to increase the variety and quantity of foods available to them. More recently, we have refined our experiments and have discovered facts basic to food production, processing, and packaging. In this unit, the student is encouraged to explore food production to find out more about these processes.

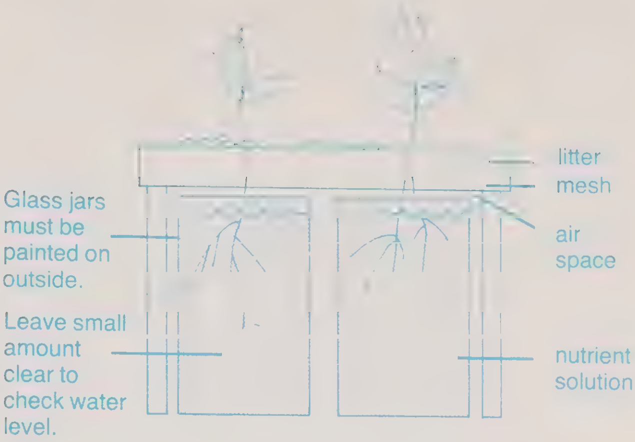
The activities suggested on the student activity sheet can be carried out according to the instructions below. The student activity sheet may be used as a focus for an introductory discussion of what is new in food development, or as the first page of student booklets in which students record details of their experiments. Other possible uses may also become apparent.

A New Way of Growing: Hydroponics (Soil-less Culture)
An old practice in plant growing has been receiving renewed attention. Where soil is lacking or unsuitable, hydroponics has been developed, both as a hobby and as a means of researching plant nutrients and nutrient deficiencies.

The initial amount of time involved is that required to prepare the planting medium and to place seeds in it. The total amount of time required will extend through the period of growth from seeds to plant maturity. In some instances, additional time may be necessary to observe and record the results (or lack of results) when an attempt is made to reproduce the new plant.

The seed bed is a frame, covered with wire mesh. It should be approximately 10 cm in depth, and large enough to cover container(s) of the nutrient solution (see Figure J2.6). It should be filled with wood shavings, excelsior, moss, or other organic material that does not decay easily. Small stones can be used, but they are heavy. Germinate the seed in sand or other material, then transplant it to the water-culture bed. Keep the bed moist until the roots get down into the solution.

Figure J2.6 — Water Culture System



The chemicals for the solution are generally available at local pharmacies and are relatively inexpensive. The chemistry department of your local secondary school may also be able to give you some help.

Table J2.3: Suggested Nutrient Solution

Salt	Grams/litre of salt for stock solution[1]
Macronutrients	
Potassium nitrate — KNO_3	101
Calcium nitrate — $Ca(NO_3)_2$	236
Ammonium phosphate — $NH_4H_2PO_4$	115
Magnesium sulfate — $MgSO_4$	246
Micronutrients[2]	
Potassium chloride — KCl	3.728
Boric acid — H_3BO_3	1.546
Manganese sulfate — $MnSO_4$	0.845
Zinc sulfate — $ZnSO_4$	0.575
Copper sulfate — $CuSO_4$	0.125
Molybdic acid — H_2MoO_4	0.017
Ferrous sulfate — $FeSO_4$	0.556

1. Multiply the numbers in this column by 0.16 to convert quantities to ounces of salt per gallon of stock solution.

2. Micronutrient salts can be combined to make one stock solution.

Source: Adapted from Ministry of Agriculture and Food, Ontario, Factsheet 73-099.

The temperatures necessary for warm-season plant growth range from 16°C to 26°C in the daytime, and 16°C at night. A great deal of light should be available. If natural light must be supplemented with artificial light, be careful not to allow the temperature range to exceed the optimum amount.

Water should be added to the nutrient solution as frequently as necessary in order to prevent the roots from drying out. If glass jars are used as containers, they must be painted on the outside to prevent growth from occurring in the roots, rather than in the top of the plant. Leave a small unpainted strip at the top of the container so that the water level can be checked. If the seedbed is going to be placed in a wooden frame, be sure that the frame is knot-free and sealed with asphalt that is free of creosote and tars.

Crossbreeding: A New Plant – The Pomato

In the animal kingdom, the crossbreeding of cattle and buffalo produces catalo. Horse and donkey crossbreeding produces mules, which are incapable of reproducing. The parallel to this in the plant kingdom is the cross-pollination of two different flowering plants by hand-pollination.

To hand-pollinate plants, you can use a small brush or piece of cotton batting to transfer pollen from the anthers of the male flower to the stigma of the female. (Male flowers tend to appear first; females can be identified by a slightly swollen ovary behind the blossom.) Sometimes the flowers can just be shaken to effect this transfer.

Usually insects carry pollen from flower to flower, but in their absence this process must sometimes be carried out by humans. This is most often necessary with vine crops, such as cucumbers, melons, and squash, although peppers, corn, tomatoes, and beans may also require it if repeated light watering has not allowed the pollination to set. Students should consider what characteristics they desire in the end-product before deciding on the plants to be crossbred. They should also discuss why they choose the plants they do. Are they looking for specific qualities, or for something new? What other reasons enter into their choices?

Grafting represents another method of crossbreeding. While grafting is usually carried out with trees, it has also been experimented with in plants. Students in one science fair grew tomato plants from seed and potato plants from "eyes". They tried both "whip-grafting" and "arching" unsuccessfully. (For information on whip-grafting and arching, see *The Gardener Catalogue – Food Gardens*, pp. 179-81.) They then took a small section of skin off a tomato plant and fitted it into a groove in a potato stem. This was bound in place and continued to grow. Production of tomatoes from the top and potatoes from the bottom was the desired end-product. Ask your students what they think the result was – and why. They can then try the experiment themselves to find out if they were right.

Selective Breeding

Students will no doubt be aware that dogs, horses, and other forms of life have been bred to accentuate certain qualities (e.g., race horses are bred for speed, dogs for hunting qualities). They should be encouraged to select the seed they plant from a "choice" vegetable or fruit. Plants such as beans that grow to maturity within a relatively short time should be selected, since it will be necessary to repeat the growth cycle using seed selected from the best of the plants produced. Several growth cycles should be carried through. The results of each cycle should be photographed or described. Students should answer the following questions: Has the quality of the food improved? Was the same earth reused for each growth cycle? Were nutrients (e.g., fertilizer) added? Which qualities were being "improved"?

Since each of these activities requires considerable time and equipment, they might be undertaken by individual students, who can report their results to the class (or in a science fair). Another alternative is to develop one or more activities to be carried out in class over a term or longer.

Related Ideas

1. Invite local tree specialists in to explain the differences among different types of grafting and the reasons for each. Cleft-grafting, whip-grafting, bridge-grafting, and shield-budding are the most common.

2. Research may be developed to explore such things as:
a) new planting methods;
b) weed and pest control;
c) the development of agriculture from early times, or at specific times (including the future).

3. Students might also wish to experiment with new alternatives in food-growing space. Traditionally, we have used hothouses and greenhouses in which the air has been heated to promote growth. Some experiments are being conducted in heating the soil instead. Students may wish to find out about such experiments, or to propose methods of heating the soil that will not be dangerous when plants are watered.

Since growth patterns are not uniform, the end results of these activities do not lend themselves to a culminating experience such as a "food day". However, charts of the periodic results of growth and/or shared sampling of the foods produced will be meaningful for students. Records in the form of graphs or pictures may be put together to form a booklet of student answers in response to "What's New?"

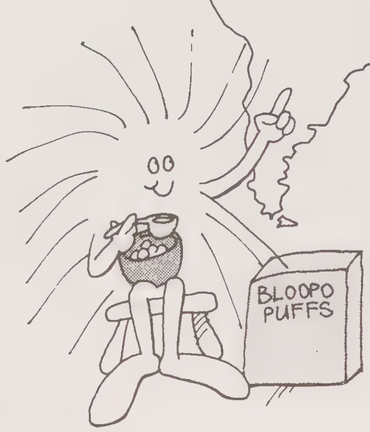
References

Ontario, Ministry of Agriculture and Food. Factsheet 73-099.

Riker, Tom, and Rottenberg, Harvey. *The Gardener Catalogue – Food Gardens*. New York: William Morrow and Co., 1975.

Name:

Where in the World Did Breakfast Come From?



Instructions

1. List all the items eaten by your family at breakfast.

2. Find out where each item came from originally. For example, did the orange juice come from California, Florida, Israel, or Spain?

3. On a map, draw a line to join each country that supplies you with food to the place where you live.

Where in the World Did Breakfast Come From?

Notes
We tend to take a variety of food for granted. Coffee and tea are on the shelf, juice is in the refrigerator, and there is often a fairly wide choice of other items available, from bacon and eggs to guava jelly. In this activity students should develop an appreciation of the variety to which they have become accustomed, and an awareness of the energy costs entailed in this variety.

Students may be asked to start this unit by listing what they had for breakfast. They should then identify the country each item came from; if all items are from Canada, they should identify the parts of Canada from which the items came. (If appropriate, a map of Canada could be substituted for a world map. The title of this activity would then become "Where Did Breakfast *Really* Come From?".) When the sources of all breakfast items have been identified and noted on maps, some of the following activities can be undertaken.

Follow-up Activities
1. Pictorial or word chains showing the *people involved* in all aspects of getting food from the earth to the table may be made. For example, if the food is fish, the chain might include ship-builders, people who catch fish, freezer service people, processors, packaging designers, truck drivers, warehouse workers, and salespersons. These jobs could also be acted out, either by the whole class or by one or two students, with the rest of the class guessing what the job is.

2. Job-description cards could be completed by the class and offered for individual choice. (Ask students whether they prefer to be a fertilizer processor and compactor, or a nutritionist; a wheat farmer or a truck driver; and why.)

3. Students might also match up jobs or machines and products with the sources from which they derive their energy. For example:

Sources	*Workers*
sun	farmers, people who fish, etc.
oil	truck drivers, machine operators

or

Sources	*User*
sun	specific foods
oil	specific machines, trucks, packing-agent ingredient (plastic)

Individual, group, and class discussions will be necessary in developing these activities. Points that could be made in discussions include:

a) the distances that food must travel;

b) the types and quantities of energy involved in transportation;

c) refrigeration requirements of transportation and storage;

d) the degree to which the processing and packaging of food make the end-product "energy-intensive" (e.g., the energy wasted in packaging potato chips in bags inside of boxes);

e) the numbers of people involved in the food industry directly (e.g., bakers, farmers, processing-plant workers) and indirectly (e.g., factory workers who make cans for peaches, people who repair the machinery used in processing, storing, etc.).

Before mechanization, one unit of "input" energy often produced an "output" value of approximately five units. Now anywhere from five to ten units of "input" energy may be required to manufacture one unit of "output". Students should be able to determine some of the reasons for this reversal after they have completed their discussions and activities in this unit. They might, for instance, compare the amount of energy required to bring to the table one loaf of bread in 1979 with that required in 1879.

A film suggested for use with this activity set is *Toast*, available from Energy, Mines and Resources Canada, 580 Booth Street, Ottawa K1Y 4G1. It would be preferable to use the film near the beginning of the set, or as a review of all the steps involved in producing a common food.

Related Ideas
Students may wish to undertake further discussion and research on the following questions:

1. Why does a dish of strawberries in January require more energy to get to the table than a similar dish in June?

2. How is unseasonably cold weather in Brazil during the coffee-growing season apt to affect a family food budget in Ontario?

3. What might we have for breakfast if we had to gather the food and prepare it ourselves?

4. Who could afford chilled juice for breakfast in early Rome? How was it provided?

5. What would a breakfast menu look like in China? Italy? Haiti? In another place of interest? How and why are such menus different from each other?

6. Compare what you imagine to be the typical breakfasts of a millionaire, an astronaut, a farmer, and an office-worker with your own. Who do you think is best fed, nutritionally speaking? Which breakfast would likely cost the least in dollars? Who is most likely to use the least amount of energy-intensive (expensive) foods?

7. Why is an energy-intensive food expensive both in terms of dollars and energy input?

Reference
Toast. Energy, Mines and Resources Canada, 1974. 16 mm, colour, 15 min.

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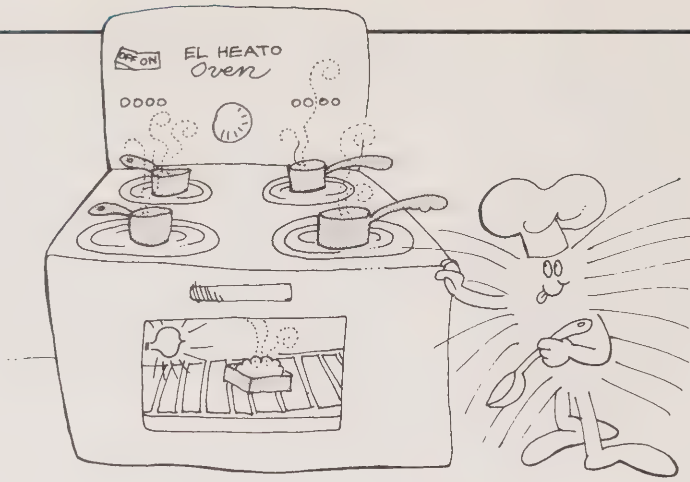
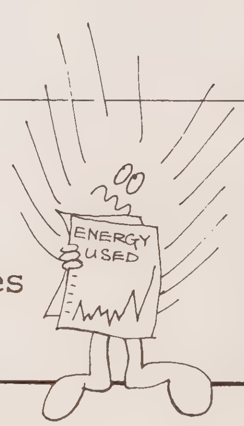
Switch



Instructions

Sometimes we get our food as the result of "energy-intensive" actions, which increase the energy input in the food without increasing its energy value to humans. What alternatives can you suggest to make each of the following less energy-intensive?

1. chopping carrots for salad in a blender ____________________
2. eating strawberries for dessert in January ____________________
3. baking a cake by itself in the oven ____________________
4. placing warm foods in the refrigerator for storage ____________________
5. boiling three different vegetables in three different pots ____________________
6. boiling a full kettle of water for one cup of tea ____________________
7. baking a fruit pie ____________________
8. making a grilled cheese sandwich ____________________
9. eating potato chips ____________________
10. buying new food supplies when you are tired of leftovers ____________________



What other common, energy-intensive practices can you add to this list?

Notes

In this unit, students are encouraged to compare a variety of food-preparation methods and to determine the most suitable methods in different circumstances. Where feasible, they should carry out a variety of food-preparation methods in class (or at home), so that their conclusions are based on their own experiences. It is to be understood that few classes will attempt all activities, although they may discuss them all. A variety of activities has been presented to give sufficient choices for a variety of circumstances in Ontario.

The student activity may be used as the starting point of this activity set. The activity may be followed by a discussion of available preparation alternatives, the length of time food is to be kept, and available storage space.

Follow-up Activities

1. Either the whole class or individuals in it may try a very old method of food preparation – sun-drying. The temperature must be at least 38°C and the humidity should be low for several days. Prepared food should be placed on clean trays and protected from insects by using cheesecloth. The cheesecloth should be kept away from direct contact with the food, which is turned once a day. Small-sized pieces of food dry most easily (vegetables work best). It will take three to four days to dry 1 cm cubes. When the food is prepared for eating, the water must be replaced by soaking, cooking, or both. Any quantity of dried vegetables is equal to eight to twelve times that quantity of fresh vegetables. Ask students to suggest what disadvantages or advantages there are in this method of preparation. (Hot June days are ideal for this activity.)

2. An alternative to sun-drying is oven-drying. Load two to four clean trays with a total of no more than 2 kg of prepared vegetables. (Do not mix odorous vegetables, such as turnips, with others.) Vegetables should be in a single layer. Preheat the oven to 71°C and place the trays in the oven. Prop the oven door open about 10 cm. A fan may be placed at the oven door to circulate air. Keep the temperature at 60°C during drying (which may take from 6-16 h). Turn the vegetables frequently to prevent scorching (particularly during the later stages of drying). Beans or corn prepared in this manner will be dry and brittle when the process is complete. Your students can now consider the following questions: What advantages or disadvantages are there to this method of preparation? How much energy is used in processing the food in the subsequent, final preparation? Do you prefer the taste and/or appearance of food prepared in this way over food prepared by other methods?

3. Students could find out how much energy is used in a day by the freezers and refrigerators in their homes. They could then compare quantities of energy used and factors that cause increased usage. For example, placing hot foods in a refrigerator cause it to do extra work (use extra energy) to cool the contents. Similarly, frozen foods take longer to cook in an oven than do foods that are not frozen.

Students can follow the steps below to determine the amounts of energy used by freezers and refrigerators:

a) Place a tape recorder beside a freezer for, say, half an hour to tape the sound of the freezer motor when it comes on. Play the tape back and record how much of the time the freezer was using energy. Determine the wattage of the freezer, and compute usage for a span of 24 h.

b) Tape-record the motor of a refrigerator and follow the same steps as in (a) to compute energy usage for 24 h.

c) Which appliance is drawing electrical energy for the longest period of the day? Which appliance has the highest wattage? Which uses the greatest amount of energy? What other factors might cause either appliance to use more electricity? If students do not have freezers at home or tape recorders available, alternative activities using other appliances follow.

4. Students might make the following comparisons of alternative cooking methods:

a) An item is cooked on the stove top using an open pot; a second, similar item is cooked in a pressure cooker. Which takes longer? Which uses more electrical energy?

b) One potato is baked in a microwave oven and another in a regular oven. Which takes longer? Which uses more electrical energy? Would this change if twelve potatoes instead of one were baked? How else could the potato be baked? Why doesn't everyone use a microwave oven? A fire-pit?

c) Equal amounts of vegetables are cooked in a frying pan and a wok[1] until they are tender but still crisp. Which method is faster? What kinds of energy were used?

d) A glass of water is heated in a pot on the stove. A similar quantity of water is heated in a microwave oven. Is there a difference in the amount of time required to heat the same amount? Why is water heated less efficiently in a microwave oven than are foods?

Related Ideas

1. Have students make a "time-line", showing cooking methods from the past into the future. They may use pictures or words.

2. Students may research the effects on foods of improper cooking and processing. Key words they will encounter include: parasites, botulism, salmonella, mould, spoilage, food-poisoning, pasteurization, sterilization.

3. Students might visit a local food-processing plant, institutional food-preparation centre, or the kitchen of a restaurant or fast-food outlet. What uses are made of energy? Which energy sources are used? In what amounts, related to numbers of customers?

4. Students may prepare foods as early settlers might have done, by smoking or salting. What are the advantages and disadvantages of these processes? What people still use these processes? Why?

5. Have students determine what energy savings can be made when the members of a family eat together rather than at different times. Where might cooking be eliminated to reduce energy consumption? (Raw vegetables or salads rather than cooked vegetables may be served. Does anyone eat raw meat, or use cheese or nuts instead of meat?)

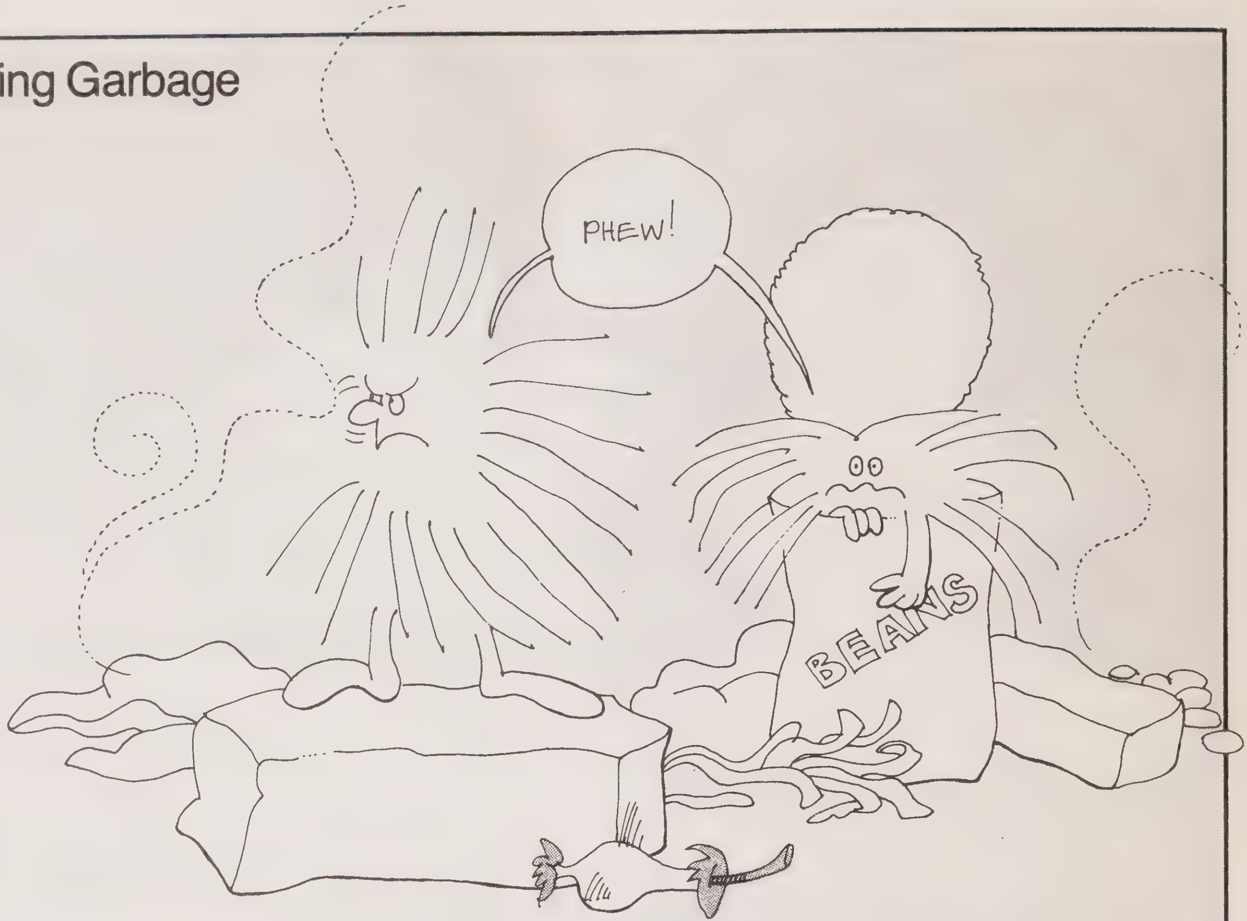
Reference

Riker, Tom, and Rottenberg, Harvey. *The Gardener Catalogue – Food Gardens*. New York: William Morrow and Co., 1975.

1. A wok is a cooking device of Oriental origin. Foods are cooked over a flame, using a small amount of cooking oil. Foods cooked in this way retain a notable crispness.

Name:

Reusing Garbage



Instructions

1. Spread out the contents of a bag of garbage on some newspapers.
2. Sort it into piles of like materials.
3. Could you eliminate any pile(s) by sending some of the garbage to a recycling plant?
4. Could any items (or piles) have been reused instead of discarded?
5. Could any items have been refused at their original source, rather than becoming refuse?
6. What uses can be made of garbage?

Notes

There is a common tendency to think of food as being of no further use once it has been removed from the dining table. In this unit students will learn that the processing of food from one energy form into another continues whether it is consumed or whether it becomes "garbage".

In order to carry out the activity, students should bring in bags of garbage and newspapers on which to spread it. Alternatively, the school garbage could be collected after lunch or at the end of the day for this purpose. In any case, there should be sufficient garbage to enable every student to participate in this activity. Rubber gloves may be necessary if the garbage is wet, messy, or partially decomposed. Restrictions can be put on the type of garbage used (e.g., "no food stuffs"). In some instances, the sorting might be done outdoors.

Students might carry out the activity by discussing their observations and doing a rough count of the items in each pile. Graphs may then be prepared that show:

a) the actual composition of the garbage (quantity of peelings, wrappers, etc.) by weight or number; and

b) what the composition of the garbage might have been, if there had been greater concern about energy conservation before the products were "thrown out".

The two graphs may then be compared.

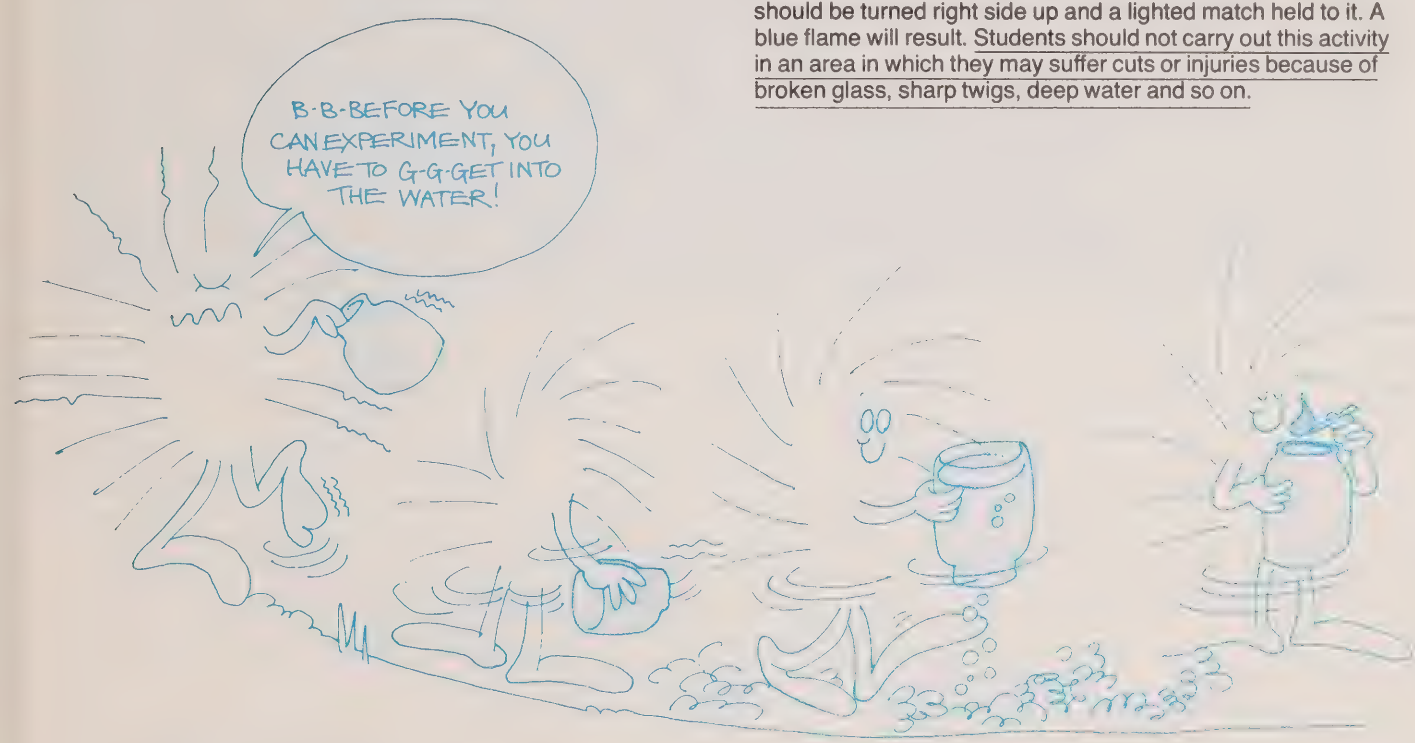
Follow-up Activities

1. Students might carry out a conservation blitz. Each student could list ways in which consumer products could be used more efficiently at home (e.g., the plastic containers used to package goods can be used for everything from hanging pots to leftover containers). How many of these suggestions are put into practice? Products may be classified as paper, glass, metal, or organic materials, and uses may be found for each category of waste.

2. Composting may be carried out individually or as a school (or class) project to enrich home or school gardens. For directions, see *The Garbage Book*, available from Energy, Mines and Resources Canada, Box 3500, Station "C", Ottawa, Ontario K1Y 4G1.

Heat is one of the characteristics of energy when it is being converted. That is why our bodies (food converters) are warm. To illustrate this further, students should take the temperature of a compost pile right after it has been started and at regular intervals thereafter. They should graph the temperatures. What conclusions do they draw from their observations?

3. Methane (the gas given off by garbage) may be collected in inverted bottles of water. Fill a wide-mouthed bottle with water. The bottle should then be placed in swamp or ditch water in which matter is decaying in such a way that the water remains trapped in the bottle. Keep the bottle in contact with the surface of the swamp water while walking barefoot over the mud and leaves. Bubbles will rise and may be trapped in the bottle. When a reasonable amount of gas has been collected, the bottle should be turned right side up and a lighted match held to it. A blue flame will result. <u>Students should not carry out this activity in an area in which they may suffer cuts or injuries because of broken glass, sharp twigs, deep water and so on.</u>



Related Ideas

1. If there is a recycling depot near the school, the students may wish to volunteer to help with it or to collect articles for it. A visit to a recycling plant and/or a class visit from someone working in such a plant would be informative. If none of this is possible, students might wish to initiate a recycling centre in the community. Directions and additional helpful suggestions for these and other similar undertakings can be found in *The Garbage Book*.

2. Students could do research into some of the following areas of garbage disposal:

a) present disposal solutions in Ontario;

b) "controlled" disposal of wastes, or anaerobic digestion. This breaking-down of organic materials occurs naturally in marshes and on lake bottoms. Scientists are now investigating the possibility of speeding up the process in order to handle wastes more efficiently, as well as to produce, as a by-product, a new fuel – methane gas:

Anaerobic digestion — A foul and pestilent congregation of vapors

Anaerobic fermentation of organic materials, producing methane gas, occurs spontaneously in marshes and lake bottoms. NRC scientists are investigating the microbiology of the process in an effort to accelerate the operation of anaerobic fermenters (digesters) which not only provide a satisfactory method of organic waste handling, but also produce as a by-product, a valuable fuel — methane gas.

The anaerobic digestion process, used in three out of four municipal sewage treatment plants in North America, can, under optimum conditions, convert about half of the organic waste load in raw sewage into methane and carbon dioxide. It is also used on a limited scale for some agricultural and industrial wastes (for example manures). Anaerobic digestion therefore is a valuable waste treatment process which, in addition to producing a residue that can form an excellent fertilizer or a good source of single cell protein for use in feed, yields a valuable by-product, methane, a usable and versatile form of energy and the major component of natural gas. As such, the process has potential as a renewable source of energy from many biological materials, including wastes, and it may provide an important source of portable fuel to augment the dwindling reserves of fossil fuels.

Source: Science Dimension, Special Energy Issue, August 1977, p. 34.

c) some of the following methods of disposal of wastes in other countries:

i) night soil gathering in China;

ii) the use of human wastes for soil enrichment in Europe during World War II when fertilizers were scarce;

iii) the burning of animal excrement (e.g., camel dung, buffalo "chips") in countries where other fuels such as wood are scarce;

iv) humus toilets (marketed as "clivus multrum"), which have been developed in Scandinavia. The basic principle is the utilization of both kitchen wastes and human wastes, which are aerated, dried out, and made usable as fertilizer for gardens. This still leaves the problem of disposing of the "grey water" — the water used in baths or in the kitchen sink. Students may wish to explore the use of humus toilets in Ontario, since they have been considered practical for rural settings. Local by-laws regulating usage and specific conditions required for the most efficient usage could also be researched.

3. Students interested in language might like to compile a list of expressions based on waste (e.g., "by the sweat of his brow", "a rotten apple in every barrel", or the computer term "garbage in, garbage out").

4. Experiments into the biodegradability of a variety of articles may be conducted and the results graphed with bars to show the article indexed to the time it takes to decompose. Students might like to carry out these experiments on an individual basis, each having a "garbage garden" at home, or the whole class could have one at school; alternatively, the class could take a walk in spring to record what has happened to the litter left out over the winter. This last alternative is the least scientific, because (a) there is no means of determining the time that each item has been decomposing; and (b) some items may have completely decomposed and not be recognizable. However, students will probably conclude that:

a) metals rust and therefore will need a long time to decompose;

b) paper goes soggy and falls apart and therefore will need a relatively short time to decompose;

c) glass is relatively unaffected by decomposition, etc.

5. Students might research how ground water is affected by the chemicals we throw out in our garbage.

6. Students may conduct interviews or take tours of local water-purification/sewage-treatment facilities.

The selection of any or all of these activities should be in accord with student ability and interest. At the conclusion of the activities, a definition of "garbage" should be elicited. Is everyone's definition the same? Has it changed during the study? Is garbage regarded as a problem or a solution? The film *Bate's Car: Sweet as a Nut* can be used to stimulate further discussion on this topic.

References

Bate's Car: Sweet as a Nut. National Film Board, 1974. 16 mm, colour, 15 min.

Energy, Mines and Resources Canada, *The Garbage Book*. Ottawa: Minister of Supply and Services Canada, 1976.

National Research Council of Canada. "Anaerobic Digestion". *Science Dimension*, Special Energy Issue, August 1977, p. 34.

Name:

Special Food	Where Served	Meaning of the Food
1. turkey	Canada, U.S.A	Part of Christmas or Thanksgiving celebration
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		

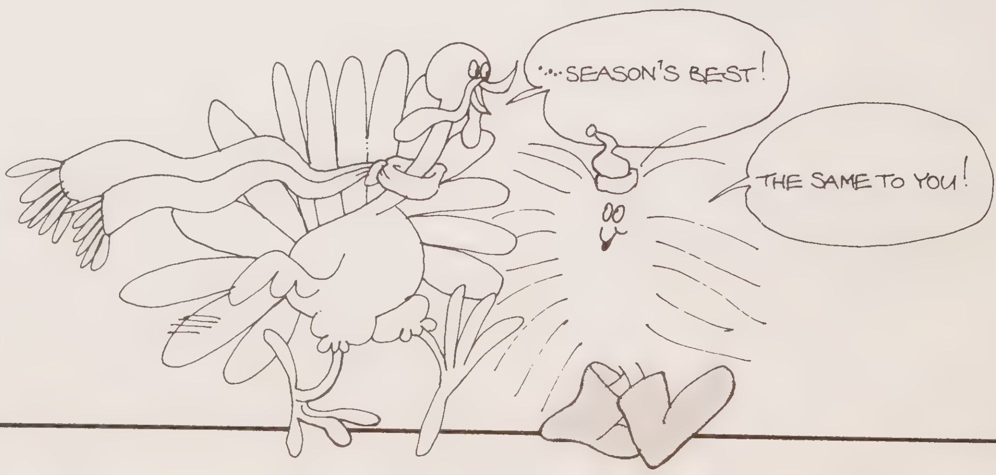
Instructions

1. List as many "special" foods as possible.

2. Under "Where Served", list in what country (or countries), or by what special group within a country, these foods are used for celebrations.

3. In the last column indicate the significance of the food.

More food for thought: What is a "special" food in your own home? How did it get its meaning?



Notes

In most households, special foods are used to mark the celebration of holidays or commemorative occasions. The birthday cake is a good example. This activity set is directed towards the development of student awareness of what food "means" to people and explores *some* food-related ideas and customs of different groups.

Students may be asked to fill out the student activity sheet individually, or, if the ethnic groupings in the class warrant it, by groups. If the latter alternative is chosen, each group may wish to provide recipes or samples of "their food", along with a verbal presentation. This activity could be extended into a special "night" to honour the ethnic groups in the community.

Follow-up Activities

1. We have associated food with physical energy. However in most religions there is a spiritual energy derived from sacraments, and from the occasions of feasting. This is often a source of individual spiritual strength and a source of group social cohesion.

The reasons for group food habits (e.g., fish on Friday or not eating pork) may be investigated. It is suggested that students do research by contacting knowledgeable people in the community as well as by reading books in the library in order to answer such questions as the following: What foods have a religious significance? What is the significance? How does it relate to other beliefs?

2. Local eating practices may also be observed, noted, and discussed. Students might try to answer such questions as: Why do people wait for their host and/or hostess to start eating? Among lower animals in their natural groupings, which one eats first? Last? Students will observe that, in a fish tank, the "boss" eats first, followed by the others in accord with their "status" in the community.

In earlier days, this rank-ordering was practised in castles and manor houses, where social rank was indicated by whether one sat "below the salt" or closer to the head of the table. In present times, rank is indicated by such things as: (a) the public eating places frequented; (b) the choice and price of the food selected; (c) the numbers of people "serving" the consumer; (d) the way in which the food is served (crystal, silver, table linens, candles, music).

3. Students might find pictures of people eating in a variety of situations (e.g., "The Last Supper", at home, in a spaceship). They should decide what the people in the pictures are saying to each other and present these conversations through a medium of their own choice. They may also consider whether the conversation is serious or witty and whether the people are apt to use any special expressions related to food (e.g., "bread of life", "bread upon the waters", "Let them eat cake," "Something is fishy," "Nuts!"). Students should discuss why the pictures present what they do. Do they find the style of clothes, hair, and food-serving practices in the pictures different from their own? An alternative to this activity is to have students list as many expressions based on food as possible and then illustrate them by a picture, a cartoon, or a mural.

Related Ideas

1. Students might research early eating practices and compare them with their own. For example, only kings or emperors could afford "runners" to fetch snow and ice to chill drinks or foods in Greek and Roman times. What limitations did this place on other people? What food do we take for granted that were not even available to kings (e.g., ice cream, popsicles, other frozen foods)?

2. Utensils for the preparation of foods have made a major impact on how food is served. The earthenware pot allowed early people to boil foods that previously were cooked on a spit or in stone-lined cooking pits. Have your students consider questions such as the following: What implications did this have for nutrition? For health precautions? For variety? What other utensils have been developed? Students might "picture" the kitchen utensils of 1000 years ago; 100 years ago; the present; the future.

3. Food is a special source of energy. Students could be asked to complete a series of verbal statements or a sequence of pictures to show how food serves as an "energy" source for both mental and physical effort.

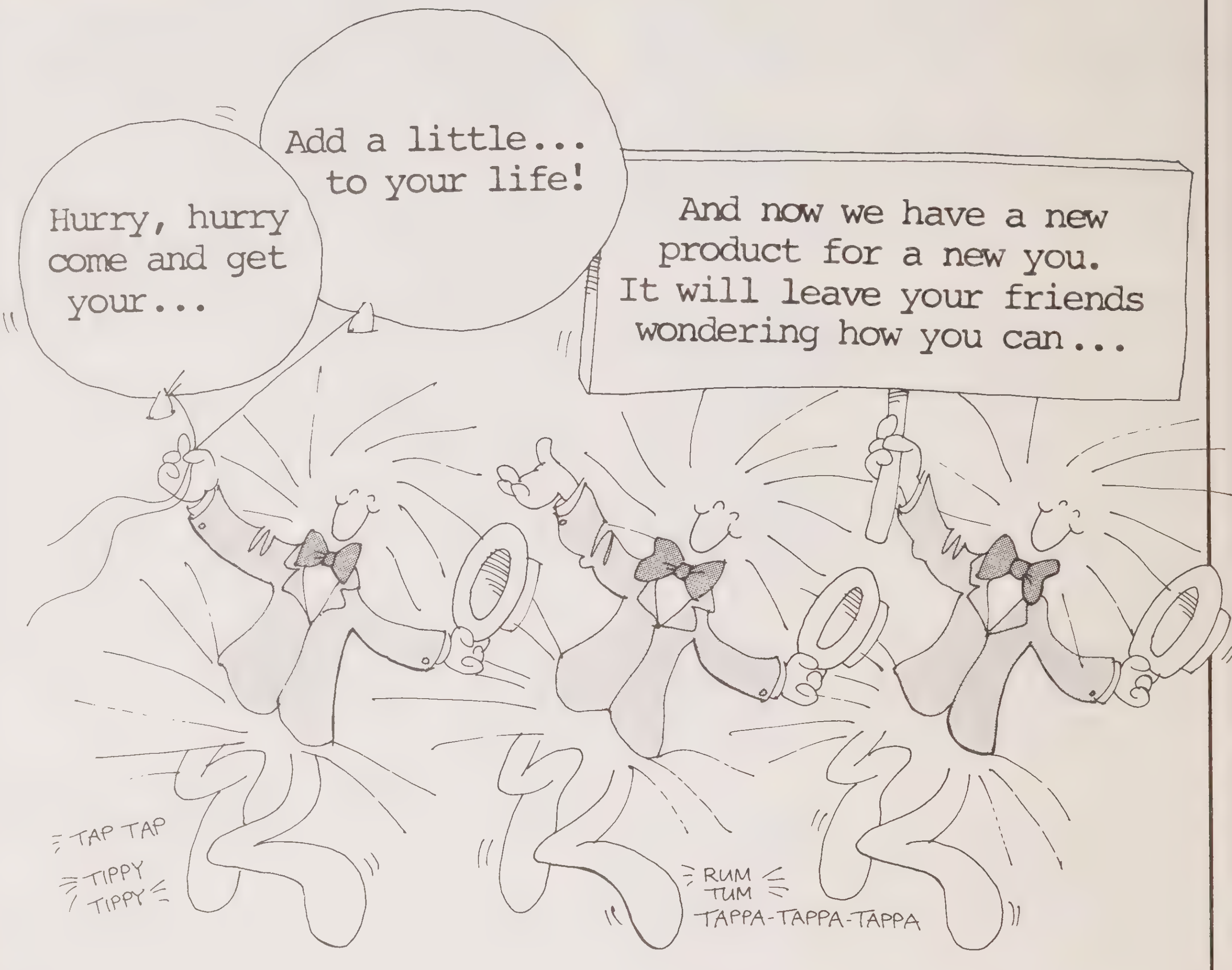
4. The "personal" meaning of foods may be discussed with students. What does it mean to them to: (a) share a special treat with someone; (b) be sent to bed without supper; (c) have a bottle of pop with the gang; (d) have gum or candy offered to people around them, but not to them? Are there other "hidden" food messages? What do food advertisers try to convince consumers of to get them to buy their products? Do people use food as a "pacifier" (e.g., "Be a good boy and I'll make you your favourite dessert," or conversely "Gee, Mom, you're great when you makė my favourite . . .". Do people nibble when tired, tense, unhappy, or lonely)?

Students could also discuss why people give the meanings they do to food. For example, why have serving practices changed in such matters as the order in which people are served? (Primitive man ate before his mate and children, but today it is still considered good manners to allow a lady to be seated and served first.)

5. Students should be encouraged to find out as much as possible about the development of food and the meaning of it. For example, we're told that some early societies used to sacrifice humans to their gods. The humans were later replaced by human replicas in the form of cookies by some societies over 3000 years ago. The genesis of the fruitcake could also be traced. Originally it was a plum porridge of meal, fruit, and whatever else was available to honour guests at Christmas. This became thickened into a plum pudding, savoury with spices reminding Christians of the three wise men. Then the pudding became a fruitcake, which was served to guests at the festive season. Each piece eaten in a different home at the holiday season was supposed to signify a happy month in the year ahead. (If you had twelve friends who were willing to give you food from their store in mid winter, you would indeed have been happy in early times in Canada, for your strength and ability to survive depended on friends and family sharing over the winter.)

Name:

Future Foods



Instructions

1. Complete the slogans above with words appropriate to an imaginary new product that you have developed.

2. Add additional slogans that you would use in promoting it. Which media would you use? Why?

Notes

People are interested in new food products. This activity set builds upon that interest to help students discover what steps are involved in developing a new product, as well as to stimulate consideration of alternative ways of producing food.

Students or groups of students may be given the student activity sheet and asked to develop the idea for a new product. They should first discuss the new product and then develop an advertising campaign and advertising slogans for it. Factors that students would have to consider in the development of the food include:

- Is research necessary before a first sample can be produced?
- Is special equipment needed to plant and/or harvest the product?
- Are special fertilizers or nutrients needed to grow it?
- What other growth conditions are necessary for year-round production (e.g., greenhouses, "grow" lights)?
- Are there special storage requirements?
- How is it prepared or processed for commercial use?
- What packaging is appropriate?
- Should it be "double-packaged" to allow for advertising?
- How is it to reach the markets?
- How will it be kept until the customers buy it?
- How will the customers get the product to their homes?
- How will they store it until they want to use it?
- How will they prepare it for use at the table?
- How much clean-up will be necessary because of it?
- How will packaging be disposed of?
- What waste will the product produce? Will the waste be usable or will it result in pollution?
- To what extent is the product "energy intensive"?

In deciding how to promote this new product, students might consider the following questions:

- What specific attributes are there to the product? (For example, is it of low, medium, or high energy content? Can it make you smart – is it brain food?)
- Perhaps portability is a factor. Is the product dehydrated, and if so, would there be long-term effects on the body, resulting in skinny-bodied, large-headed people, for example?
- Perhaps the product allows you to read the thoughts of others or to understand all languages. If so, do the effects last or do you have to keep eating more of the product? Are there curative powers in the food? (Perhaps it keeps cold away or lets you live forever.) Are the effects in any way reversible?
- If the food has the property of giving special effects to the consumer, would these effects be different for a space-traveller and yourself? For rich people and poor people? For you now and you in twenty-five years?
- Would the food be eaten as part of everyday life or on special occasions only?
- Would it be a food eaten as a "convenience" or fast food, or one requiring gourmet presentation?
- Would it be made available through a computerized food-delivery system? How would changing your mind affect the system?
- Would it be used because people "eat to live", or because they "live to eat"?
- Where in the pyramid of life are the sources of the food drawn from?

The students should be encouraged to use whatever media they have available to promote their products (e.g., posters; audio tapes; TV – if your school or board has videotape recorders available; or personal sales talks). They should be able to enjoy their proposed product by using their imaginations.

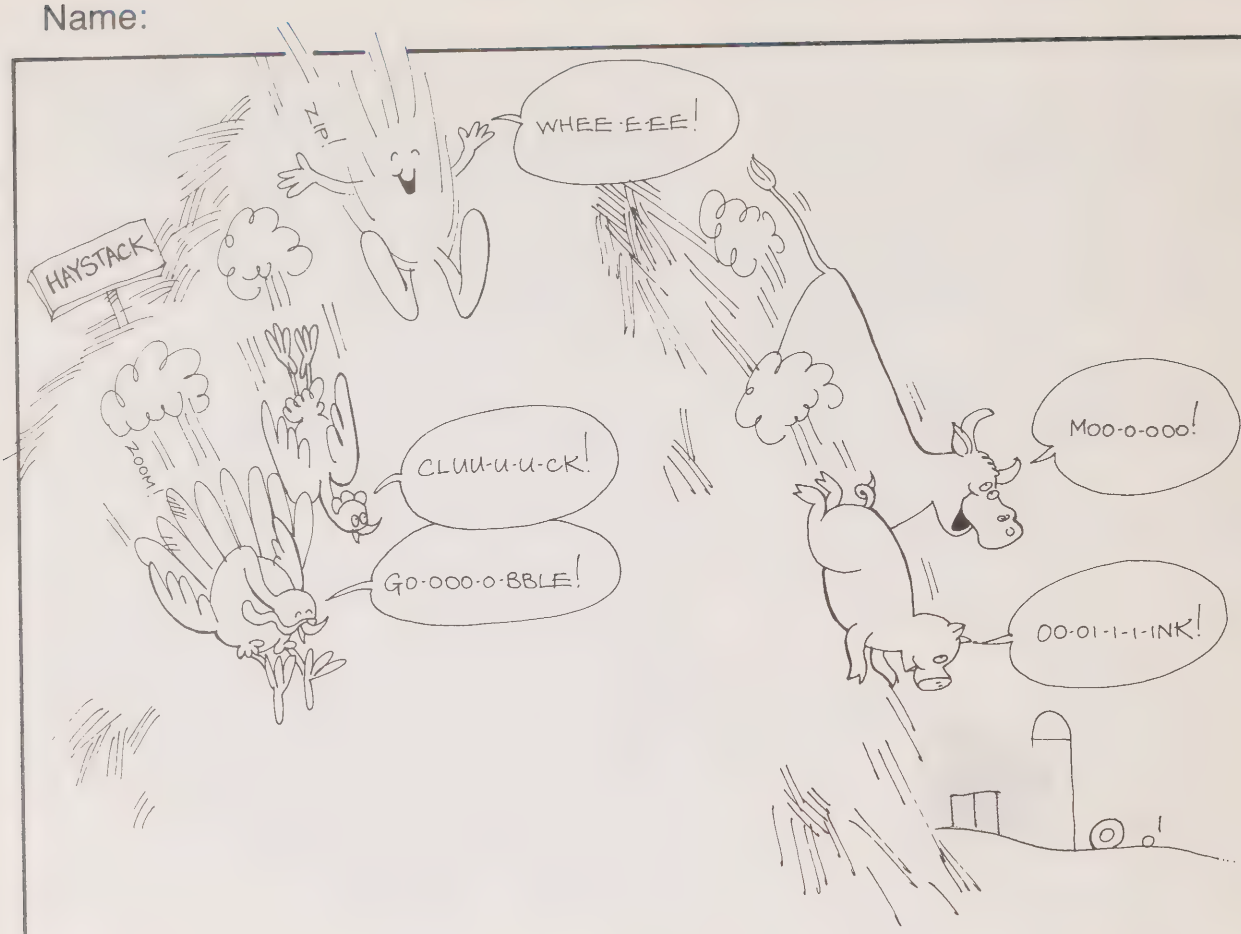
After the fun is finished (use your own judgement in this), the serious aspects of the activity should be examined: What would the energy costs of such a product be? Would the value of the product warrant the investment? A parallel can be drawn to the development of potato chips. Does the energy (nutritional value) gained justify the energy investment?

Other foods could be examined in similar fashion: Just what is food anyway? The conclusion of this activity would be an appropriate time for students to re-examine the definition that they gave at the start of their study about food. Ask them whether the definitions have changed, and if so, in what ways.

There should now be an increased awareness of: (a) the degree to which various foods are energy-intensive; (b) their relationship to or nutritional value for the body systems; (c) the ways in which the food and body systems relate to and affect other systems feeding into the pyramid of life (e.g., mercury poisoning in fish – the food system – feeds into the body's nervous system causing damage resulting in changes – death, decomposition – reflected in the pyramid of life); (d) the fact that energy in food may be converted through either the body or the "garbage" system; and (e) the fact that life systems are affected by human intervention and that a change to any part of a system causes changes to other parts of the system.

This activity provides, in effect, a review of preceding units and should therefore be used near the conclusion of all activity sets related to food.

Name:



Instructions

1. List the foods that might be produced on the farm for a balanced diet.

2. List the equipment needed to produce these foods.

3. List other necessities for production. Include storage spaces, means of repair, means of getting water, seed, fertilizer, etc.

4. Make a sketch or model of Old Macdonald's farm showing an actual farm and building layout. Be prepared to explain how the various parts of the farm work together.

Things to think about:

Is one farm large enough to be self-sufficient? Would your eating habits be different on a self-sufficient farm? How would you keep workers happy down on the farm? Would the workers need any special services (e.g., medical, social)? What would be your power source to run the farm equipment? Would it be necessary to limit the number of people on the farm or to have an "ideal" number on it to run it efficiently? How would you cope with emergencies?

Notes

The self-sufficient "ark" has many supporters in principle, although there are few who have been able to make it a reality. By the conclusion of this unit of work, students should be more aware of the difficulties faced by self-sufficient communities. They should have explored the ideas and ideals of some existent communities, as well as the practical aspects of being part of such communities. This should lead to some projections about communities of the future.

Initially, the students may choose to work as a class or in small groups. If individuals wish to work separately, they should be allowed to do so. (In this way, they may develop an appreciation of the contributions that others can make.)

The first "community decision" relates to finding a location for the farm. An actual site in the local area should be chosen. Questions like the following should be considered: Is the ideal site already occupied? What is the best alternative? Is a neighbouring community apt to encroach upon the site through expansion? Are there environmental conditions about the site that might make it liable to expropriation (e.g., for an airport, a power line)? Is there an unpolluted source of water adequate for potential needs? What other factors are critical to the community?

The second decision revolves around work allocation. This includes questions like the following: Who does what? For how long? Why? How else could jobs be filled in the event of sickness, accident, etc.? How would job training be carried on? How would compensation be calculated? Would those doing the "dirtiest" jobs get the most reward? To what extent would degree of training and/or knowledge be rewarded? What would happen if some community members got tired of doing a job and either decided to slow down activity or go on strike? What other work problems may arise?

The third area of decision-making relates to social interchange. This includes the following questions: What arrangements would make the most sense in the community in terms of people getting along together and helping each other? What services would be considered essential (hospital, police, fire, sanitation)? If these services were not provided from outside the community or if specific services were not set up in the community in these areas, how would emergencies be met? Would schools of some sort be necessary? For whom? Who would teach in them? Who would make the decisions in the community? A mayor? A council? Everyone? Some combination of these? Other?

In order to give depth to these discussions, students should get information on how communities are run: How is their own run? What services are provided? How are communes run? How have religious communes (e.g., Amish, Hutterite, Quaker, and Mormon communities) been organized? Is religion an important factor in the continuity of communes? (To date, some central belief pattern appears necessary if a commune is to endure for any length of time.) How can the spiritual values of the commune be decided on? What provision is made for dissident views?

Some of the foregoing ideas may be deemed inappropriate for class discussion in certain communities. However, students should have enough questions raised to give them practice at decision-making and to help them realize that alternatives usually exist if they are but sought.

Other questions may also arise: Is interdependence of communities desirable? To what extent is it necessary? How large is the "ideal" community? How does size contribute to the amount of electricity and/or other energy forms used? What are some of the advantages and disadvantages of a large community? To what extent is individual privacy necessary? Desirable? When does "public interest" take precedence over private concerns? Should we take variety for granted?

The issue of independence versus interdependence may be debated. Presentations may be made by groups of students representing hypothetical or real communities. The problems of each may be discussed, and their possible solutions suggested. Are the arrangements between interdependent communities always equitable?

Related Ideas

Students might like to explore a broad range of possible communities. They might consider, for example, what a future community would be like:

- on the moon
- in a space station
- at the bottom of the sea
- at the South Pole
- in a Malayan jungle
- in the Kalahari Desert
- on a tropical island
- on top of Mount Everest
- inside a human body (or in a single cell)
- in the middle of the earth
- in an apartment building (Could sufficient gardening be done on balconies?)

Conditions of life would have to be determined for each location and provision made for a safe supply of oxygen, water, and food; pressure factors might have to be considered as well. If community residents could not adapt to the conditions, special inventions would have to be devised to provide the necessities of life. Sources of energy would have to be provided for, and the means of its conversion found. To what extent would each community be self-sufficient in energy? Could the community perhaps supply other communities with energy?

Students could develop a "balanced system" in an aquarium containing plants and fish. This activity could lead to work on plant and animal adaptations.

Glossary

Adaptation. The ability of plant and animal life to change in order to survive.

Anaerobic digestion. The breaking down of organic materials in water in order to isolate and dispose of contained water. This process produces methane gas.

Biodegradability. The ability and rate at which a product breaks down into elements that can mix with the natural elements.

Calories. References in this document are to "kilocalories" or "large" calories. A calorie is the energy required to raise the temperature of 1 L of pure water by 1° C.

Composting. The treatment of organic material to speed up the process whereby fibres and cells are broken down into elements that may be used to enrich soil.

Conversion. The process whereby one form of energy is changed into another form.

Crossbreeding. The combination of two different species of animal to produce offspring that has some characteristics of both parents, but that does not have the ability to reproduce itself (e.g., a horse and donkey produce a mule).

Cross-pollination. The combination of two different plants to produce a "new" plant that has some characteristics of both "parents" (e.g., a potato and a tomato plant produce a "pomato").

Energy-intensive. An energy-intensive product is one that requires a great deal of energy in its manufacture.

Hydroponics. The growing of plants in a water and chemical mixture.

Interdependence of systems. Life is a series of interlocking "systems". A change in a part of one "system" will affect other "systems". (For example, the cutting down of trees removes birds' homes, thereby removing the birds which would kill insects which eat neighbouring crops.)

Kilojoules (kJ). A Calorie equals 4.2 kJ.

Nutrients. Energy-producing elements necessary to the maintenance and development of life.

Photosynthesis. The process whereby plant life converts the energy of the sun to a form of energy that is consumable at a higher level of life.

Pyramid of life. A flow chart demonstrating the prey-predator relationships in which the predator converts (consumes) ten units of energy from a lower level (prey) in order to produce one unit of energy at its own (predator) level.

Recycling. The reprocessing of a product to enable part or all of it to be used again.

Selective breeding. Breeding within a species to accentuate certain qualities (e.g., the breeding of race horses as opposed to draft horses).

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